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MARINE ECOSYSTEM SERVICES OF ST. HELENA PART 2: ECOSYSTEM SERVICE VALUATIONS, FUTURE DEVELOPMENT THRESHOLDS AND MANAGEMENT

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**MARINE ECOSYSTEM SERVICES OF ST. HELENA
PART 2: ECOSYSTEM SERVICE VALUATIONS, FUTURE DEVELOPMENT THRESHOLDS AND
MANAGEMENT**

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Executive Summary

The Millennium Ecosystem Assessment (MEA) established the concept of ecosystem services on the global agenda as the “benefits people obtain from ecosystems” (Millennium Ecosystem Assessment, 2005). Ecosystem services comprise of the flows of energy, material and information from stocks of “natural capital” (the stock of materials or, quite simply, the ecosystem) (Costanza et al., 1997). The St Helena Government recognises that the natural environment (the natural capital) of St Helena supports the well-being of the island residents and, if used sustainably, will provide the foundations for future economic growth (St Helena Government, 2015).

The entire 200nm Exclusive Fisheries Zone (EFZ) of St Helena has recently been designated as an IUCN category VI “protected area with sustainable use of natural resources”. The marine management plan for the 444,916km² Marine Protected Area (MPA) has also been formally adopted. The plan sets out management strategies for the marine environment that aim to protect marine biodiversity and ensure sustainable resource use. At present, there is a key evidence gap in understanding the relationship between marine conservation, marine management measures and the social and economic benefits generated by fisheries and tourism on St Helena. As part of the Darwin Plus project “The sustainable development and management of St Helena’s fisheries and marine tourism” 2015-2017 an Ecosystem Service Assessment (ESA) was undertaken in two phases to provide an in-depth understanding of the links between the marine environment and the realisation of ecosystem service benefits. This will strengthen the underlying evidence for marine planning and facilitate progress towards local and regional goals along with broader ambitions for sustainable development as outlined under the United Nations (UN) Sustainable Development Goal (SDG) 14 “Life Below Water” to “conserve and sustainably use oceans, seas and marine resources for sustainable development” (United Nations, 2015)

Established in the first phase of the ESA, the ecosystem services of commercial fisheries; recreation and culture, spiritual and tourism were considered by workshop participants to be at the highest risk of ‘change’ as the island economy develops. In order to support marine management planning the second phase of the ESA, which commenced in March 2016, undertook a mixed methods approach (literature review, interviews, secondary data collation, stakeholder workshop) in order to:

- Provide baseline values (monetary and non-monetary) of ecosystem service benefits;
- Determine the critical pathways (and interactions) between the ecosystem and the ecosystem service benefits for those ecosystem services identified as being at most risk from change; and
- Identify sustainable use thresholds for future management.

A number of ecosystem service indicators were identified for which there were data available to make a baseline assessment of the value of the beneficial ecosystem service, along with an interpretation of how that indicator has changed recently over the time. This interpretation is either based on time series data (where available) or local/expert opinion.

Summary table of ecosystem service indicators and associated monetary and non-monetary valuation metrics. The time series trend shows if the data series has been positive (+), negative (-) or remained stable over time (+/-) for which data were available.

Beneficial ecosystem service	Indicator		Valuation metric	Time Series trend
Fisheries	Total	Value (£)	£198,157^a	-
	Fishing vessels	Number	12	+/-
	Landings	Weight (kg)	251,572	-
		Purchase Value (£)	£152,000	-
	Sales	SHFC (£)	£25,157	-
		Local (kg)	68,720	+
		Local (£)	£179,000	+
		Export (kg)	116,000	-
		Export (£)	£146,000	-
	Jobs	At sea	34	+/-
		Processing	25	Currently downsizing
Recreation and Culture	Total	Value (£)	£214,048^b	+
	MTOs	Number of operators	4	+
		In-use vessels	9	+
	Jobs	At sea and on land	7FT/7PT	+
	Scuba Diving	Trips per year	270	+
		Number of people on trips	3286	+
		Value (£)	£88,618	+
	Sport Fishing	Trips per year	52	+
		Number of people on trips	252	+
		Value (£)	£10,900	+
	Wildlife Interactions	Trips per year	311	+
		Number of people on trips	4009	+
		Value (£)	£58,645	+
	Wildlife Watching	Trips per year	199	+
		Number of people on trips	2037	+
		Value (£)	£40,645	+
	Scenic trips and island drop off/pick up	Trips per year	149	+
		Number of people on trips	746	+
		Value (£)	£15,240	+
Cultural	Fishing - rocks	Reported frequency of activity	Medium	No data available
	Fishing - boat	Reported frequency of activity	Medium	No data available

Beneficial ecosystem service	Indicator		Valuation metric	Time Series trend
	Water sports	Reported frequency of activity	Low	No data available
	Sailing	Reported frequency of activity	Low	No data available
	Swimming	Reported frequency of activity	High	No data available
	Spearfish	Reported frequency of activity	Low	No data available
	Day by sea	Reported frequency of activity	High	No data available
	Snorkelling	Reported frequency of activity	Low	No data available
Spiritual	Inspiration	Reported frequency of activity	Very High	No data available
	Looking at the Sea	Reported frequency of activity	Very high	No data available
Tourism	Total	Value (£)	£853,802^c	+
	Cruise	Passenger numbers	2,633	+
	Cruise and Passenger Ships	Number	19	-
		Expenditure (£)	£113,025 ^{c1}	+/-
	Yachts	Number of vessels	178	+/-
		Number of Passengers	621	+/-
		Number of Passengers (stay longer than 3 days)	327	+/-
		Expenditure (£)	£104,357 ^{c2}	+
	Transit passengers	Number	138	+
		Expenditure (£)	£34,666 ^{c3}	+
	Tourist passengers	Number	754	+
		Expenditure (£)	£601,754 ^{c4}	+
	Jobs	Numbers employed in supporting sectors	146FT/63PT	
^a Total value from sales minus purchases. ^b The combined monetary value of each recreation activity. All values are presented in an aggregated format and are calculated from approximate values provided by the MTOs either as: charge per boat per day x number of trips per year; or (the number of trips per year x average number of people per trip) x cost per person. All values represent turnover and not profit. ^c The combined value of expenditure across each of the tourism groups e.g. yachts, cruise and passenger ships. There may be double counting of values with recreation and cultural as the 'daily spend' may include trips taken with the MTOs. ^{c1} (No. of Persons * Landing Fee) + (No. of Persons * Estimated Spend)+ Cruise and passenger fee vessel ¹ (harbour dues and pratique) ^{c2} Yacht Fee ² (Light dues + mooring x average length of stay) + Person Spend (number x daily spend x average length of stay) + (permit fee and additional spend for those here >72 hours) ^{c3} Person Spend (number x daily spend x average length of stay)+ (1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * stay on Ship transit fee) ^{c4} (No. of Persons * Landing Fee & Estimated Spend)+(1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * Avg Spend on SC Acc * Avg length of Stay)				

The fishing industry and the associated values are currently highly variable across years. A number of thresholds that signal unsustainable development have been crossed. Most notably, a decline since 2011 in economic values associated with this ecosystem service due to both ecological factors and market forces. Tourism and recreation are currently the main growth areas with high values associated with seasonal wildlife watching trips. The most valuable recreation activities are directly associated with wildlife interactions e.g. scuba diving and swimming with whale sharks (*Rhincodon typus*). Sport fishing is also a high value market but is,

as yet, undeveloped on St Helena. Any declines or loss in the marine species that underpin these activities will have a direct impact on associated values.

Tourism is an ecosystem service benefit which creates approximately £0.8million per annum in expenditure. Positive knowledge and perceptions of the marine environment are essential to maintain these values. Negative knowledge or perceptions about the marine environment for example health scares (e.g. illness from sewage); safety issues (e.g. collisions at sea); collapse in fish stocks affecting food supply; and visual disturbance (e.g. litter) can undermine these values.

The most popular recreation activities, those that are associated with the local culture include a 'day out by the sea' and 'swimming'. There is a spiritual element to recreation activities that include simply 'looking at the sea' and gaining 'inspiration' from the sea. Local residents reported a 'very high' frequency of activity associated with these activities. It must be considered that these interactions are invaluable as there is no means by which to accurately reflect the numerous health and wellbeing benefits of the interactions with the blue environment (Depledge & Bird, 2009; Wheeler et al., 2012).

Workshop participants identified a positive "desired future" for the marine environment where:

- The marine environment is valued;
- Marine management is integrated, effective with sufficient operational capacity and resources;
- The natural environment is managed holistically;
- Stock management (commercial and recreational) is underpinned by robust science;
- Recreation activities are managed and monitored (species and habitats);
- There is a thriving export and local market in fish products;
- Tourists are satisfied with their experience of the natural environment on St Helena and;
- Development is managed to support a quality over quantity product for both fisheries and tourism.

Processes to achieve this vision are largely within local control with suggestions for greater integration across sectors, a dedicated enforcement officer and increased capacity in annual monitoring programmes.

Future avenues to further support sustainable economic development on St Helena include: the development of Natural Capital Accounting to include the value of the physical environment e.g. the marine environment and the value of the ecosystem services e.g. recreation, fish into the national accounting balance sheet. Any gains and losses in the natural capital can then be monitored in relation to economic development; The implementation of performance management targets based on social-ecological indicators which can be monitored to determine if management measures are effective or not; an exploration of a system for the payment for ecosystem services where annual licence fees or tourist taxes can be levied to support environmental management; and finally the development of a hub for research excellence on St Helena, making research excellence central to the broader sustainable development of the island economy is an opportunity to raise the profile of St Helena as a top class eco-tourism destination.

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1. Introduction

The Millennium Ecosystem Assessment (MEA) established the concept of ecosystem services on the global agenda as the “benefits people obtain from ecosystems” (Millennium Ecosystem Assessment, 2005). Ecosystem services comprise of the flows of energy, material and information from stocks of “natural capital” (the stock of materials or, quite simply, the ecosystem) (Costanza *et al.*, 1997). There is growing evidence that areas that have effective marine management in place, utilizing Marine Protected Areas (MPAs) as a management tool, can have positive effects for biodiversity (Edgar *et al.*, 2014; Sciberras *et al.*, 2015; Sheehan *et al.*, 2013). MPAs help maintain and enhance flows of ecosystem services that support human wellbeing, for example, by supporting sustainable food provision and opportunities for recreation (Arkema *et al.*, 2015; McCook *et al.*, 2010; Rees *et al.*, 2015; Roberts *et al.*, 2001).

Marine management planning can be challenging. The establishment of an MPA can potentially touch upon numerous socially charged issues which, if ignored or compartmentalized, can result in the failure of the MPA to meet the objectives for which it was primarily designed. Indeed, research shows that because MPAs are at the interface between social and ecological systems, short term biological gains associated with MPA designation may be compromised unless social issues, specifically notions of equity resulting from the impact of the MPA designation, are addressed in the planning and management process (Rees *et al.*, 2013).

The St Helena Government recognises that the natural environment (the natural capital) of St Helena supports the well-being of the island residents and, if used sustainably, will provide the foundations for future economic growth (St Helena Government, 2015). The marine conservation section of the Environmental Management Division (EMD) have developed a draft marine management plan that proposes to encompass the entire 200nm Exclusive Fisheries Zone (EFZ) as an International Union for the Conservation of Nature (IUCN) Category VI “protected area with sustainable use of natural resources”, also including an IUCN category III protected area “natural feature” at Lots Wife’s ponds (St Helena Government, 2016). The marine management plan, which is currently in a consultation phase, sets out management strategies for the marine environment that aim to protect marine biodiversity and ensure sustainable resource use. At present, there is a key evidence gap in understanding the relationship between marine conservation, marine management measures and the social and economic benefits generated by fisheries and tourism on St Helena.

1.1. Ecosystem Service Assessments

Ecosystem Service Assessments (ESAs) are widely used as a decision support tool for marine policy and planning (Börger *et al.*, 2014). ESAs can serve to provide an in-depth understanding of the links between the marine environment and the realisation of ecosystem service benefits. Additionally, the assessment method can also be applied to demonstrate how the ecosystem service delivery may change under different types of management (Pendleton *et al.*, 2015). To further support marine management, a preliminary ESA was convened on St Helena in September 2015. Using the ‘triage approach’ designed by Pendleton *et al.* (2015) the purpose of ESA, in the first phase, was to build a common understanding with stakeholders of the:

- The ecosystem services/benefits that flow from the marine environment of St Helena;
- The ‘significance’ of the ecosystem service to the local stakeholders; and
- The perceived level of ‘sensitivity’ of the identified ecosystem service to change.

The first phase of the ESA revealed that there is a high level of awareness amongst St Helena stakeholders of the links between the marine environment and ecosystem service benefits realized by the local population. Seventeen ecosystem service benefits were identified (Table 1). The ecosystem services of commercial fishing tourism, nature watching, tradition and culture,

heritage (built heritage), spiritual benefits and recreation opportunities were considered by workshop participants to be at the highest risk of ‘change’ as St Helena moves towards a new future which involves the development of the tourist economy (Table 1).

Table 1 Significance and sensitivity of marine ecosystem services of St. Helena. Exposure to significant risk is calculated as the assessment of significance (A) plus the sensitivity of the ecosystem service (B) where high risk (3), medium risk (2) and low risk (1).

	Assessment of significance	Sensitivity of ecosystem service	Exposure to risk score
Service / benefit	A	B	A+B
Commercial fishing	High	High	6
Tourism	High	High	6
Nature watching	High	High	6
Tradition and culture	High	High	6
Heritage (built heritage)	High	High	6
Spiritual	High	Medium	5
Sport fishing	Medium	High	5
Recreation	Medium	High	5
Water supply	Low	Medium	3
Waste treatment	Medium	Low	3
Renewable energy	Low	Medium	3
Access / Transport	Medium	Low	3
Salt production	Low	Low	2
Carbon capture	Low	Low	2
Raw materials (Sand mining)	Low	Low	2
Coastal hazard protection	Low	Low	2
Climate regulation	Low	Low	2

The second phase of the ESA which commenced in March 2016 aims to:

- Provide baseline values (monetary and non-monetary) of ecosystem service benefits;
- Determine the critical pathways (and interactions) between the ecosystem and the ecosystem service benefits for those ecosystem services identified as being at most risk from change; and
- Identify sustainable use thresholds for future management.

Defining and setting baselines for ecosystem services through the ESA method will strengthen the underlying evidence for marine planning and facilitate progress towards local and regional goals along with broader ambitions for sustainable development as outlined under the United Nations (UN) Sustainable Development Goal (SDG) 14 “Life Below Water” to “conserve and sustainably use oceans, seas and marine resources for sustainable development” (United Nations, 2015).

2. Methods

2.1. Literature review

The ecosystem services of commercial fishing, tourism, nature watching, tradition and cultural heritage (built), spiritual benefits and recreation opportunities were considered by workshop participants to be at the highest risk of 'change' as the island economy develops. From an ecosystem service assessment perspective we will define the ecosystem service benefits as:

- Commercial fisheries;
- Recreation and culture;
- Spiritual; and
- Tourism

We recognize that tradition and culture are interlinked with all of these ecosystem service benefits. Nature watching is closely aligned to, tourism, recreation and spiritual benefits. The ecosystem service benefit of heritage (built) will not be taken forward to the ecosystem service assessment as its delivery is not dependent on the ecological functions of the natural environment.

A literature review was undertaken making use of both peer review and grey sources to provide the context of each beneficial ecosystem service in terms of: i) an overview; ii) critical pathways; that consider basic information on habitat, diet and pressures of key species; and iii) current management.

2.2. Data

To evaluate ecosystem services it is necessary to identify data that can be used as an indicator to assess value and change. Indicators (jobs, monetary values, well-being indices etc.) can provide measures of ecosystem processes and ecosystem service benefits, allowing for study of the linkages between ecological, social and economic systems and changes in relationships over time (Bohnke-Henrichs et al., 2013; Hattam et al., 2015). Indicators were selected based on knowledge of the secondary data sources that could be accessed on St Helena (collected by the relevant agencies) and primary data that could be readily collected on a field trip to St Helena via questionnaire and interview (Annex I). The following ecosystem service indicators were identified along with the means of data source (Table 2).

Table 2 Ecosystem service indicators and data sources

Beneficial ecosystem service	Indicator	Data available from
Fisheries	Number of fishing vessels	Agriculture and Natural Resources Division (ANRD)
	Landings (weight and value)	Agriculture and Natural Resources Division (ANRD)
	Sales (weight and value)	Agriculture and Natural Resources Division (ANRD)
	Jobs	Agriculture and Natural Resources Division (ANRD)
Recreation and Culture	Number of Marine Tour Operators (MTO)	Questionnaire/Interview
	Jobs	Questionnaire/Interview
	Number of trips per year	Questionnaire/Interview
	Number of people on trips	Questionnaire/Interview
	Turnover (£)	Questionnaire/Interview
Cultural	Reported frequency of activity	Environmental Management Division (EMD)
Tourism	Number of passengers	Statistics Office, Corporate Policy and Planning Unit (CPPU)
	Type of passengers	Statistics Office, Corporate Policy and Planning Unit (CPPU)
	Expenditure	Statistics Office, Corporate Policy and Planning Unit (CPPU)
	Jobs	St Helena Tourist Office

All data were analysed using Microsoft Excel. Financial data were aggregated for purposes of data/identity protection.

2.3. Future management

A workshop was convened on St Helena where workshop participants were invited to:

- Validate current knowledge of links between the ecosystem and the ecosystem service benefits for species targeted by commercial fisheries and the recreation businesses and consider future development scenarios for St Helena's marine environment;
- Develop future management scenarios (extreme and desired); and
- Map drivers and trends that are either barriers or enablers to achieve a desired future management scenario.

The full workshop agenda is included in Annex II and the knowledge for validation included in Annex III. Data from the workshop were transcribed. The workshop was recorded to provide verification. Data were analysed and discussed within the context of marine management and the protection of natural capital on St Helena.

3. Fisheries

3.1. Overview

The main type of fishing on St Helena is pole and line with fishermen mainly using *Decapterus* sp (Kingston, stonebrass) and mackerel (*Scomber japonicas*) as live and cut bait (St Helena Government, 2016). The dominant commercial target species are the tunas (grouped as yellowfin (*Thunnus albacares*), bigeye (*Thunnus obesus*) and longfin/albacore (*Thunnus alalunga*), skipjack (*Katsuwonus pelamis*), wahoo (*Acanthocybium solandri*) and grouper (*Epinephelus adscensionis*). The pole and line fishery is considered to be a relatively 'clean' fishery with limited bycatch (Carleton et al., 2010). Species such as sharks (various species), billfish (various species), Dorado (*Coryphaena equiselis*), Cavalley (*Pseudocaranx dentex*), Yellowtail (*Seriola lalandi*) and Filefish (*Canthidermis sufflamen*) are caught as bycatch. With the exception of some shark species the majority of bycatch is retained for sale or personal consumption (Carleton et al., 2010). Spiny lobster (*Panulirus echinatus*) and Slipper lobster (*Scyllarides obtusus*) are also targeted with fishermen using pots though it is believed that the majority of catch is not processed through the official market.

3.2. Critical pathways

Oceanic productivity in the waters around St Helena is driven by the South Equatorial and Benguela currents (Choat JH & Robertson DR, 2012). These currents drive nutrient rich waters from the coasts and upwelling regions of Africa and South America around the South Atlantic Gyre. Nutrient enriched waters support both primary and secondary production, ecological functions that underpin the food webs in the region. The island and the seamounts create physical underwater barriers that drive dense, cool and nutrient rich waters to the surface, providing localized pockets of enhanced productivity (St Helena Government, 2010). The commercial fishery in St Helena is dependent on the following species.

3.2.1. Tunas and highly migratory fish

Tunas largely inhabit the surface waters of the pelagic water column and generally feed within the top 30m of water. Like most mobile marine species the tunas and highly migratory fish are attracted to areas of high productivity. Therefore the patterns of migration can shift in response to changes in oceanographic conditions. Stomach content analysis of tunas has found crustaceans, molluscs and fish are all part of the diet (Pearce et al., 2009). The tunas are a schooling fish. In the juvenile and young adult life history stages, yellowfin (*Thunnus albacares*) and bigeye tunas (*Thunnus obesus*) will school with skipjack, often relying on larger features such as seamounts, whale sharks (*Rhincodon typus*) and drifting objects for refuge (Carleton et al., 2010). In the adult phases, oceanic features serve to aggregate tunas. It is unknown whether these aggregations or migratory feeding patterns in St Helena's waters are essential to the tuna life cycle. Billfish (*Istiophoridae* and *Xiphiidae*) such as the blue marlin (*Makaira nigricans*) are largely an oceanic fish not seen in coastal areas unless there is a steep drop off. The diet mainly consisting of tuna like species, squid, crustaceans and cephalopods (Nakamura, 1985). Similarly swordfish (*Xiphias gladius*) are oceanic, opportunistic feeders focussing foraging activity mainly above the thermocline (Nakamura, 1985). All these species are of high commercial importance and are therefore vulnerable to fishing pressure. Their migratory and feeding patterns are influenced by oceanographic conditions which makes them vulnerable to the effects of climate change.

3.2.2. Grouper (*Epinephelus adscensionis*)

A reef associated species, usually solitary, that mainly feed on crabs and smaller fish (Heemstra & Randall, 1993). It is considered that the isolation of St Helena means that the abundance of Grouper population is predominantly influenced by local effects (e.g. temperature, fishing effort)

as there is minimal larval exchange between broader Atlantic populations (Choat JH & Robertson DR, 2012). There is a relationship between the size of grouper and distance from points of human access (Choat JH & Robertson DR, 2012), indicating that fishing (commercial and recreational) places a direct pressure on this species. Grouper form spawning aggregations which presents a period of vulnerability to targeted fishing pressure.

3.2.3.Wahoo (*Acanthocybium solandri*)

Wahoo are an oceanic, epipelagic species that can be found as solitary species or as loose aggregations (Collette et al., 2011a). The diet mainly consists of fish and squid. This species is vulnerable as bycatch in purse-seine and longline fisheries (Collette *et al.*, 2011a). The use of FADs has been associated with increased by-catch mortality of wahoo (Gaertner et al., 2015).

3.2.4.Dorado (*Coryphaena equiselis*)

Dorado (*Coryphaena equiselis*) are primarily an oceanic species, occasionally coastal that forms large schools. These species are attached to floating objects such as boats or FADs. The predominant diet of these species is smaller fish and squid. As a fast-growing short-lived species there is not considered to be an overt pressure on these species from fishing. A small commercial market exists for this species (Collette et al., 2011b).

3.2.5.Filefish (*Canthidermis sufflamen*)

An epipelagic fish, these species form small groups and are mostly associated with floating objects, reefs, drop offs and land points that force swift oceanic currents. The species will feed mainly on algae, small invertebrates and corals. A small commercial fishery exists for this species. This species is particularly vulnerable to fishing pressure during spawning aggregations (Leis et al., 2015).

3.2.6.Yellowtail (*Seriola lalandi*)

This species is benthopelagic found in coastal and ocean waters usually in association with rock features. Normally solitary or found in light shoals these species feed on small fishes and squid. Fishing poses the only direct pressure though it is of limited commercial value but is considered to be a good sport fish (Smith-Vaniz & Williams, 2015).

3.2.7.Mackerel (*Scombridae*)

Mackerel are a coastal pelagic species that forms schools. Feeding is driven by diurnal patterns, where fish feed near the bottom during the day and nearer the surface at night. Fishing and climate change pose the only direct pressures to these species.

3.2.8.Spiny lobster (*Panulirus echinatus*) and Slipper lobster (*Scyllarides obtusus*)

Spiny lobster (*Panulirus echinatus*) are associated with rock substrates at a depth of 0-35m often making use of crevices and caves for shelter (Butler, Cockcroft & MacDiarmid, 2011). Slipper lobster are associated with the same rock habitats but found at depths 9-55m (Lavalli, Spanier & Grasso, 2007). Spiny lobster are omnivorous, making use of a wide range of food sources including fish, crustaceans, green algae, calcareous algae, and rocks (Butler, Cockcroft & MacDiarmid, 2011). Slipper lobster feed predominantly on bivalves (Lavalli, Spanier & Grasso, 2007). Given the low mobility of these species abundance is directly attributed to local effects (fishing pressure, climatic changes).

3.2.9. Glass Eye Snapper (*Heteropriacanthus cruentatus*), Squirrel fish (*Holocentrus adscensionis*), blackbar soldier (*Myripristis jacobus*), Octopus spp

These species occur over structured habitats (rock, rubble and reef) with a wide depth range. These species generally utilise sheltered crevices and ledges and during the day and feed at night on small fish, octopi (fish species only), crabs, polychaetes and pelagic shrimp (Dooley et al., 2015; Moore et al., 2015b; Moore et al., 2015a). These are minor commercial species and are predominantly targeted for fresh fish (Dooley et al., 2015; Green et al., 2007; Moore et al., 2015a).

3.2.10. Cavalley (*Pseudocaranx dentex*)

A coastal species that forms schools usually in association with reef, rock and wreck structures, and juvenile fish feed on small invertebrates and fish that live over sand and algal substrate. This species is considered to be vulnerable to fishing pressure during spawning aggregations. (Smith-Vaniz et al., 2015).

3.2.11. Conger Eel (*Conger oceanicus*), Moray Eel (*Gymnothorax* spp.)

Conger and moray eels share similar habitat requirements, living in holes and crevices with either rock or sandy bottoms. These may be reef or wreck environments. Both species hunt at night. Eels are opportunistic carnivores feeding on a wide variety of species.

3.2.12. Mackerel shark (*Carcharhinus galapagensis*)

A reef associated species, with a preference for areas with strong currents. Oceanographic features such as oceanic islets and pinnacles serve to aggregate these species. This species feeds mainly on demersal prey (fishes and cephalopods). This species is not considered to be resilient to the pressures caused by fishing due to life history parameters (age of maturity and breeding cycles) (Bennett, Gordon & Kyne, 2003).

3.2.13. Mako Shark (*Isurus oxyrinchus*.)

A migratory epipelagic species that mainly feeds above the thermocline on teleost fish species and cephalopods (Cailliet et al., 2009). Mako are a high value commercial fish though severe declines in populations attributed to low population increase rates and a high fishing mortality have led some regional fishery organisations groups to instigate management plans to promote recovery (Cailliet et al., 2009; Dulvy et al., 2008). Mako shark are caught in high numbers by the pelagic longline fisheries, often as bycatch to the commercial swordfish and tuna fishery (Cailliet et al., 2009).

3.3. Management

Fishermen can operate within the whole EFZ which covers an area of 444,916km² (St Helena Government, 2016). The Inshore Fishing Area (IFA) is defined by the 30nm limit (122km²) though the majority of fishing takes place within a few miles from land. More recently the offshore waters and the seamounts are being exploited by the local commercial fisheries.

St Helena's fishing sector has representation on the International Commission for the Conservation of Atlantic Tunas (ICCAT), through the UK delegation. ICCAT is responsible for setting catch quotas or effort controls for Tunas and tuna like species in the Atlantic Ocean. The following species that are caught by St Helena fishermen have quota allowances that have either been set by ICCAT or through local measures (Table 3).

Table 3 St Helena Fish Quota Allowance

Beneficial ecosystem service	Sub section	Value
Yellowfin Tuna	<i>Thunnus albacares</i>	110,000t ¹
Bigeye tuna	<i>Thunnus obesus</i>	2100 t
Longfin tuna	<i>Thunnus alalunga</i>	100t
Skipjack	<i>Katsuwonus pelamis</i>	Unlimited
Swordfish	<i>Xiphias gladius</i>	25 t
Blue marlin	<i>Makaira nigricans</i>	10t ²
White marlin	<i>Kajikia albida</i>	2t ²
Grouper (jack or rock hind)	<i>Epinephelus adscensionis</i>	36t (Choat JH & Robertson DR, 2012)
Spiny lobster	<i>Panulirus echinatus</i>	Unlimited. Though 0.37t recommended (Nines, 1991)
Slipper lobster	<i>Scyllarides obtusus</i>	Unlimited. Though 0.37t recommended (Nines, 1991)
¹ Quota set for the ICCAT Convention Area ² Can only be landed under 45kg on St Helena due to mercury levels in larger fish (St Helena Government, 2016)		

Source: (St Helena Government, 2016)

Fishermen can operate within the whole EFZ though a number of restrictions on fishing activity, outlined in the St Helena Marine management plans apply within the MPA:

- Commercial bottom trawling is prohibited within the entire EFZ (Revised legislation linked to Fishery Limits Ordinance 2011);
- Tangle/gill nets, drift nets, purse seines and dynamite fishing are banned within the entire EFZ. Pelagic and semi pelagic fishing only (Revised legislation linked to Fishery Limits Ordinance 2011);
- No dolphin, or spiny or slipper lobster in berry, to be taken within the entire EFZ (linked to Environmental Protection Ordinance);
- No fishing is permitted without a licence from St Helena Government and fishing activities are regulated via the licensing criteria (Linked to Fishery Limits Ordinance 2011);
- Targeted fishing for all species of shark (including shark finning) is banned throughout the entire EFZ (Linked to Environmental Protection Ordinance 2014);
- No fishing activity of any kind is permitted within Lots Wife's ponds;
- All recreational (on boats) and commercial (tourism and fisheries) fishermen must adhere to catch limits and size restrictions as per their fishing licence; and
- No use of droppers during the spawning season (January to March) for all inshore species of ground fish (it is permissible to use for bait fishing). This applies to rock fishing and boat fishing. (St Helena Government, 2016).

For all commercial catch there is a requirement to land all catch though the St Helena Fisheries Corporation (SHFC). The SHFC is the delivery organisation for the purchase of fish, payment of fishermen, and collection of landed fish from vessels together with supply of ice, fuel and squeeze (ground up fish to attract live bait) (Brumbill, 2013). The SHFC regulates the prices within the industry and facilitates commercial activity, including the development of both local and overseas markets.

All commercial fishermen must have a commercial fishing licence which is issued by the Senior Fisheries Officer from the St Helena Government's Environment and Natural Resources Directorate (ENRD). There is a proposed requirement under this licence for fishermen to record all species of bycatch and report the fate of bycatch (released alive, released dead, retained); to adhere to quota restrictions; to allow observer monitoring; and to report non-compliance if observed. These requirements are in the process of being implemented. Capacity within ENRD for at sea surveillance and monitoring of the commercial fishing fleet is currently limited. ENRD rely on the locally owned fishing fleet, other locally operated vessels along with regular and visiting shipping traffic to report illegal, unregulated and unreported fishing (IUU). There is also capacity to receive Automated Identification System (AIS) data which enables the identification and tracking of vessels with gross tonnage (GT) of 300 or more. There is a planned programme of spot checks, observer monitoring, and inspection of data and catch records to support surveillance and enforcement.

3.4. Data

Data to assess the value of the St Helena fisheries were provided by the Government of St Helena. The fisheries statistics provided comprise of:

- The weight (tonnes) of all species landed for the years 2010 to 2015 and for the financial year years 2009/2010 to 2014/15;
- The value (£) of all species landed by date and species for the years 2010 to 2015 and for the financial year years 2009/2010 to 2014/15;
- Earnings by skipper for the calendar years 2010 to 2015;
- Crew employed for the calendar years 2010 to 2015;
- Days fished for the calendar years 2010 to 2015;
- Local fish sales by value (£) for the financial year years 2009/2010 to 2014/15;
- Fish Sales by weight (tonnes) for the financial years 2009/2010 to 2014/15; and
- Fish exports (kg) for the financial years 2009/2010 to 2014/15.

The fisheries statistics were analysed using Microsoft Excel. Results are presented to show changes between years (calendar years and financial years depending on the data provided) and average value across years (including standard deviation) where data were available.

3.5. Results

3.5.1. Number of vessels and investment

The fishing fleet of St Helena in 2016 comprises of 32 vessels (12 full time, 20 part time) though currently 8 vessels are in operation full time (St Helena Government, 2016) The majority of vessels are small (8-10m in length). A significant investment was made in the fishing fleet in 1992 when five catamarans were added though a loan/grant aid agreement. Further investment was made in 2015 through the purchase of the MFV Amalia and MFV Extractor by private companies to open up the seamount fishing grounds and increase the security of supply to the market.

3.5.2. Landings (by species weight and value)

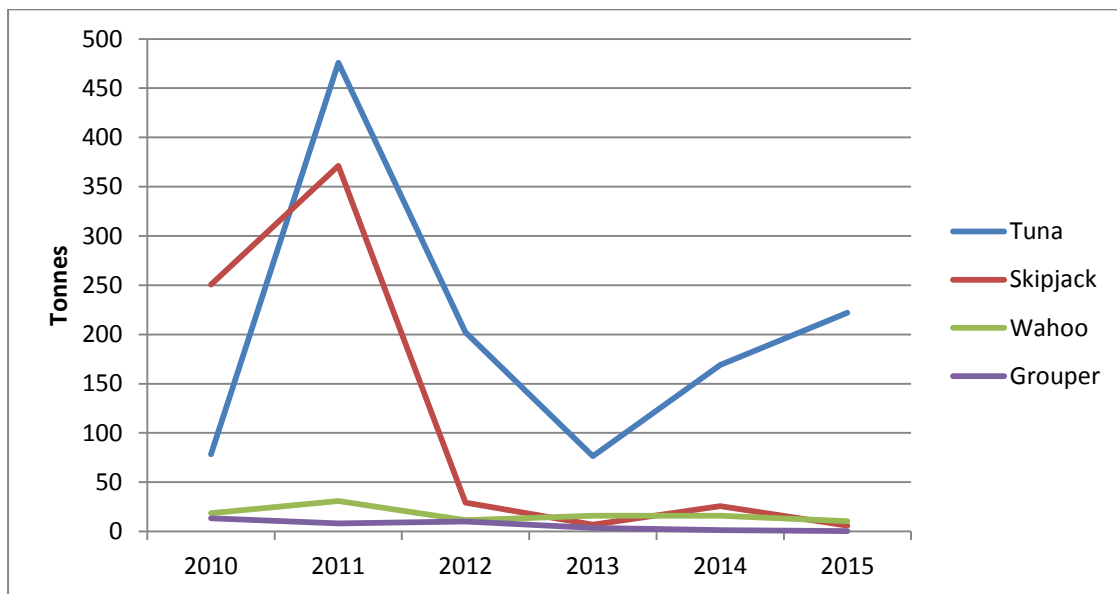
The target commercial species in St Helena and the landed weight (tonnes) are shown in Figure 1. The dominant species (in terms of weight landed) for the commercial catch is Tuna (including skipjack). Tuna data (that combines weight and value) is aggregated at the point of landing, and combines yellowfin (*Thunnus albacares*), albacore (*Thunnus alalunga*) and bigeye tuna (*Thunnus obesus*) species. There are obvious annual fluctuations in the availability of tunas, believed to be due to changes in oceanographic conditions which influences migration patterns

of these highly mobile species (St Helena Government, 2010). For the majority of commercial species there has been variability in tonnes landed since 2011. This follows a much broader picture of catch variability demonstrated by landings data available from 1977 – 2015 (Annex IV). The first sale (wet weight) price for commercial species also follows a similar pattern of variability, with a particularly 'good' year in 2011 (Figure 2). The most commercially important species in terms of value are the tunas (including skipjack). Skipjack (*Katsuwonus pelamis*) is a relatively small species of tuna with a low market value per kg. Big eye (*Thunnus obesus*) and Yellowfin tunas (*Thunnus albacares*) are larger species with a higher market value per kg.

In terms of bycatch that is landed, Blue marlin (*Makaira nigricans*) and Dorado (*Coryphaena equiselis*) are commonly landed; Black marlin (*Istiompax indica*), Sailfish (*Istiophorus*), Mackerel shark (*Carcharhinus*) and Mako shark (*Isurus oxyrinchus*) is occasionally landed; and Swordfish (*Xiphias gladius*), White marlin (*Kajikia albidus*), Thresher shark (*Alopias vulpinus*), Blue shark (*Prionace glauca*) and Hammerhead shark (*Sphyrna* sp) are rarely landed (Carleton et al., 2010).

Figure 1 Weight (tonnes) of all species landed for the years 2010 to 2015 (a) Main commercial species and (b) Other commercial species landed

a)



(b)

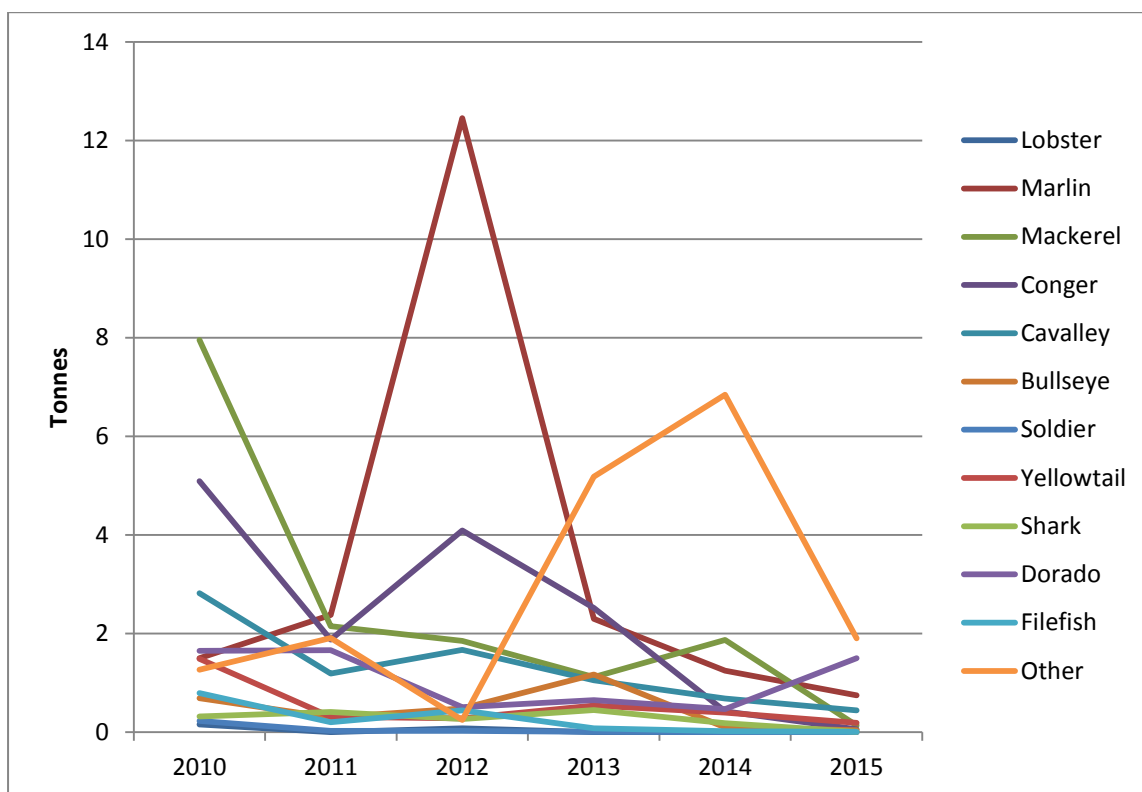
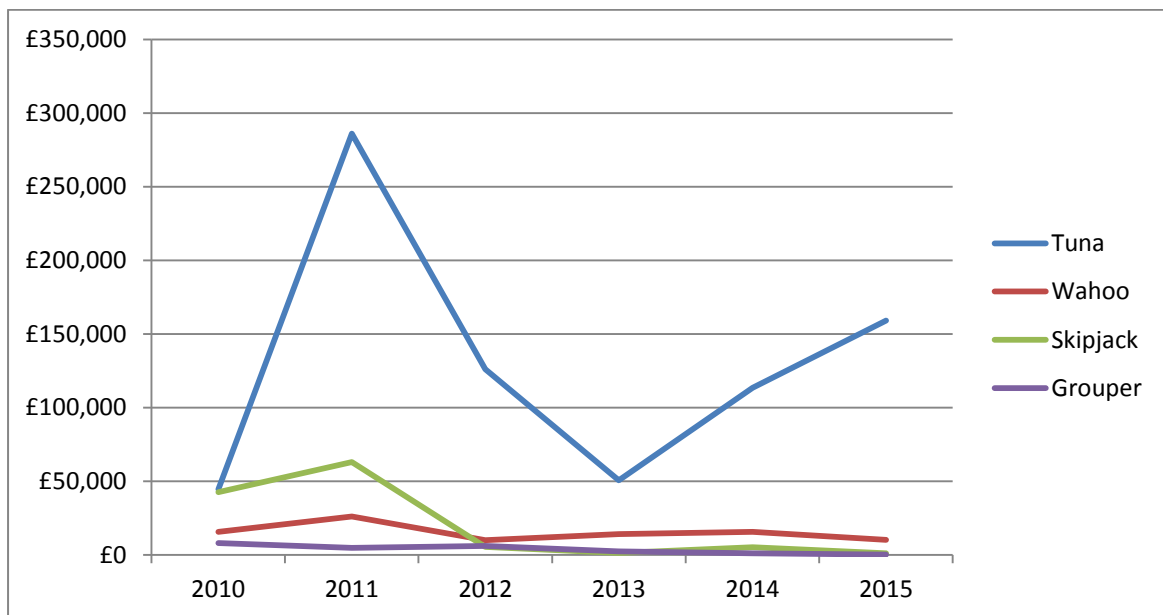
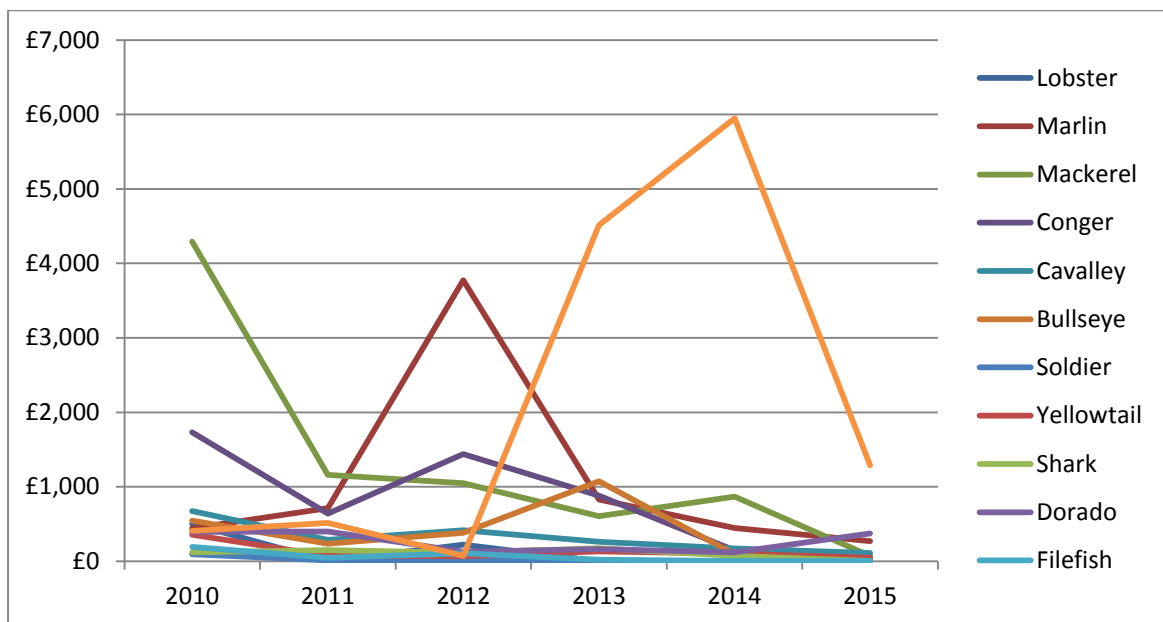


Figure 2 The value (£) of all species landed by data and species for the years 2010 to 2015(a) Main commercial species and (b) Other commercial species landed

(a)



(b)



3.5.3.Value of landings to fishermen

The total first sale value (wet weight) of species landed by the St Helena fishing fleet for the years 2010 to 2015 is shown in Table 4. The 6 year average for the first sale value of commercial species is £170,996 (+/- £108,538) per annum. Fishermen work on a share basis with one share allocated to the boat owner and one share allocated per fishermen. Crew and skipper both receive an equal share of income. If the skipper is also the boat owner then two shares are received. Based on discussions with the Senior Fisheries Officer data has been divided into boats that predominantly operate inshore, offshore or mixed (inshore/offshore). The greatest proportion of the value of the annual catch has consistently come from inshore waters (Table 4). The offshore fishery which opened up in 2014 now represents for approximately one third of the value of the total landings (Table 4).

Table 4 Total first sale value (wet weight) of commercial species for (a) All fishermen (b) Fulltime fishermen (c) part time fishermen. The average across years (year beginning January) where data were available is shown along with standard deviation to show the range in the data.

[illegible]

3.5.4. Direct Employment Opportunities

Commercial fisheries provide a number of direct employment opportunities (onboard boats) with approximately 38 (+/-7) jobs (6 year average) available per year (Table 5). In recent years there have been increasing employment opportunities to work as crew onboard the offshore boats. These figures are likely to be an overestimate of the actual number of full time and part time jobs in the industry however as the data represents the number of crew required to work a boat. It must be noted that crew members will often work on a number of different vessels throughout the year and not all vessels are at sea at the same time so the figures provided are considered to be an overestimate of the number of fishermen. The St Helena Government Private Sector Employment Survey conducted in 2010 (St Helena Government, 2010) states that there were 18 jobs in the marine sector, representing 12 full-time jobs and 4 part-time. This is believed to include predominantly fisheries but also with a cross over to people involved in marine tourism. A planned government census in 2016/2017 may provide more accurate numbers on the number of jobs directly supported by fishing.

Table 5 Direct employment opportunities in the fishing sector based on data provided by ANRD.

Jobs (skipper and crew)	2010	2011	2012	2013	2014	2015	Time series year average	SD (+/-)
All	38	46	43	27	38	34	38	7
Full Time Offshore					6	13	10	5
Inshore/Offshore	2	2	2	2	5	5	3	2
Inshore	19	20	19	18	19	16	19	1
Part time Inshore	17	24	22	7	8	2	13	9

3.5.5.Processing and sales

Commercial catch is landed in Rupert's Bay, where facilities are available for onward access to market. SHFC make a direct purchase from the fishermen (landings). Acting as the 'middle man' SHFC makes a service charge of on average £0.10 (2015 values) per kg of fish handled to cover its overheads and operating costs. This yields on average £38,337 (+/-£24,608) per year for SHFC (Table 6). SHFC also sells bait and fuel though no data were made available on the revenue generated through these sales.

Fish are then processed at a fish processing unit for sales to both the local and export market. In 2000 Argos Atlantic Cold Stores opened a fish processing and storage facility at Rupert's Bay capable of handling increased supply of fish with a view to meeting demand from the current market (local sales and export), and enabling entrance into new export markets. Fish processed by Argos were predominantly sold vacuum packed (Big eye tuna, *Thunnus obesus*) and in-round (Skipjack, *Katsuwonus pelamis*). In more recent sales the majority of tuna has been sold gutted and gilled. In 2013 it was reported that Argos operated at an annual loss of £200k per year due to the lack of fish supplied from the resource base and low market prices received for frozen products (Brumbill, 2013). In November 2015 Argos transferred the processing facility to the SHFC.

Sales onward from the fish processing unit are then sold either to the local market or for export. Local sales are predominantly of vacuum packed tuna. The main exports are tuna (yellowfin, big eye, longfin) and skipjack sold vacuum packed, dressed without tail and whole (in round). The value generated from sales has been highly variable across the 6 years with average values of £295,277 (+/-£221,306) (Table 6). In the 2013/14 financial year there were no exports. In the 2013/2014 financial year the total value achieved from sales being approximately £198,157. The SHFC currently supports 25 jobs. Jobs at the processing unit are currently being downsized to 19. No data were made available on the direct and indirect operating costs of SHFC. Given these additional costs, it is likely that SHFC is operating with very narrow margins.

4. Recreation and Culture

4.1. Overview

Tourists and locals alike take part in recreation activities that are associated with the marine environment. Each recreation activity listed below is considered to be a beneficial ecosystem service flowing from the functions and processes of the marine ecosystem. These links may be direct e.g. trips to view dolphins, or more indirect interactions, such as scenic trips, which may be more dependent on the perception of clean water and a natural environment than being primarily dependent on direct interactions with species and habitats. Marine recreation on St. Helena includes the following activities with either direct or indirect interactions with marine habitats and species. There is a growing industry of Marine Tour Operators (MTOs) who provide the services to support the recreation and cultural activities on St Helena.

Direct ecosystem service benefits

- Scuba Diving
- Sport Fishing, Spear Fishing and Recreational Boat fishing
- Wildlife Watching/Interactions
- Rock Fishing

Indirect ecosystem service benefits

- Scenic Trips
- Swimming
- Water Sports

4.1.1. Direct ecosystem service benefits

Scuba diving takes place regularly at sheltered sites on the lee side of the island. Specialized Marine Tour Operators (MTOs) with equipped dive boats take people out to visit dive sites. Of particular interest to divers are the rock and wreck sites which support a variety of marine life and a host of endemic species. Charismatic species such as Devil Rays (*Mobula tarapacana*), are a major draw for divers.

Sport Fishing is characterized as a recreational fishing trip that targets the 'sport fish' e.g. tunas (*Thunnus* sp), Wahoo (*Acanthocybium solandri*) and Blue marlin (*Makaira nigricans*). The activity is undertaken on two fronts. There are locals who use their own boats to fish for both sport and/or subsistence and there are also sport fishing boats available for charter from the MTOs. Recreational boat fishing crosses over between sport fishing and rock fishing, the species caught depend upon location. Spear fishing is reportedly growing in popularity though there is no information on current levels of activity. There has reportedly been one charter hire for spear fishing (St Helena Government, 2016) though the activity is not currently advertised by the MTOs.

Wildlife watching/interactions are provided by a number of the MTOs who have designed services focusing on both seasonal and resident marine species to support their business. Seasonal trips focus on the whale sharks (*Rhincodon typus*) and humpback whales (*Megaptera novaeangliae*). Several MTOs provide customers with an opportunity to snorkel with whale sharks (*Rhincodon typus*). Snorkeling trips are also to sites on the sheltered side of the island where there is an opportunity to see the endemic species and (occasionally) Green Turtle (*Chelonia mydas*) and Hawksbill Turtle (*Eretmochelys imbricata*). Wildlife such as the coastal

bird populations and the resident pan tropical dolphins (*Stenella attenuata*) are the major draw for the wildlife watching trips that operate year round.

Rock fishing is largely a cultural activity on St Helena with locals making use of the steep tracks down to sea level or (more commonly) making use of the MTOs and the ferry service who will drop off and pick up at coastal locations. Rock fishing, using hand lines, targets species with limited and low mobility. Target species include glass eye snapper (*Heteropriacanthus cruentatus*), mackerel (*Scombridae*), moray eel (*Gymnothorax* spp.), grouper, squirrel fish, soft back soldier and octopus (St Helena Government, 2016). Grouper (*Epinephelus adscensionis*) and Conger (*Conger oceanicus*) are the main target species (Henry, Beard & Clingham, 2014). Wrasse is used as bait. There are reported catches of spiny lobster (*Panulirus echinatus*) and mackerel shark (*Carcharhinus galapagensis*) for subsistence purposes (St Helena Government, 2016). Rock fishing activities often coincide with family trips and specific cultural festivals such as Maundy Thursday.

4.1.2. Indirect ecosystem service benefits

Scenic trips that are offered by MTO attract both locals and tourists. Underpinning the market in scenic boat trips is the knowledge and/or perception that the natural environment is beautiful. There are indeed opportunities to see the resident wildlife, but the scenic trips include opportunities to experience sunsets and some of the coastal heritage sites. Scenic trips are becoming increasingly popular with locals for special occasions (e.g. birthday parties).

Swimming is largely undertaken from the access points of James Bay, Rupert Bay and Lemon Valley. Swimming activities rely on access to water that is perceived to pose no threat to human health. Also from these access points it is reported that watersports activities such as water skiing and jet skis are increasing in popularity amongst locals.

4.1.3. Spiritual benefits

The spiritual role of the sea in St Helena was stressed significantly at the 1st workshop and being an important ecosystem service. Benefits generated include relaxation, health benefits, restfulness, connection with nature, watching the sea (especially when it is rough). It was considered that recreation activities, such as rock fishing and swimming, are not just about obtaining food but are also believed to provide have a spiritual role, providing a space to relax, think and enjoy. Workshop participants believed that activities such as simply watching the sea could have health benefits, particularly for mental health. Whilst there are no tangible economic benefits and there is no means by which to accurately reflect the numerous health and wellbeing benefits of the blue environment (Depledge & Bird, 2009; Wheeler *et al.*, 2012) it is useful to consider this beneficial ecosystem service alongside monetary valuation approaches.

4.2. Critical pathways

MTOs were asked which species their business relied upon these are summarized below. Rock fishing, sport fishing, spear fishing and recreational boat fishing are considered to target similar species to the commercial fisheries and are therefore included in the previous section without repetition here.

4.2.1. Scuba Diving

Scuba diving depends on there being something interesting to see (Rees *et al.*, 2010). It is only specialist wreck sites or unusual geographical features which may outweigh the main driver for

diving which is to interact with, explore and discover marine biodiversity. A major draw for St Helena is the variety and abundance of marine life. There are approximately seven hundred and eighty marine species of which 50 are endemic to the islands waters (St Helena Government, 2016). Endemic species are of particular interest to divers as they are unique to the diving destination.

There are also a variety of rocky reef and wreck dive sites around the island, several on the sheltered lee side of the island. MTOs stated that aside from the range of biological diversity and endemic species that can be viewed by divers in St Helena's waters, of particular interest are the corals e.g. wire coral (*Stichopathes filiformis*) and feather black coral (*Plumapathes pennacea*). As corals are generally slow growing and long lived they are vulnerable to changes in environmental variables e.g. temperature and physical pressures e.g. impact.

Other species of interest include the diversity of fish species e.g. St Helena butterflyfish (*Chaetodon sanctaehelenae*) which aggregate around wreck sites and the Devil Rays (*Mobula tarapacana*) which are highly migratory, filter feeders found around areas of high productivity such as upwelling areas of islands, pinnacles and seamounts (Pardo, Walls & Bigman, 2016). Aside from changes to oceanographic variables caused by a changing climate, in the Eastern Atlantic, the tuna purse seine fishery poses the greatest threat to Devil Rays (*Mobula tarapacana*) as they are caught as by-catch (Pardo, Walls & Bigman, 2016). Devil Rays (*Mobula tarapacana*) are also sometimes targeted opportunistically by foreign offshore fleets for meat and the gill plates for international trade in Chinese medical products (Pardo, Walls & Bigman, 2016).

Both species of turtle found on St Helena Green Turtle (*Chelonia mydas*) and Hawksbill Turtle (*Eretmochelys imbricata*) are highly migratory and utilize a broad range of habitats in different geographical locations throughout their lifetime. Beaches are essential for the nesting phase. Hawksbill turtles mainly forage on sponges whereas green turtles predominantly forage on algae (Bjorndal, 1980). The predominant threats to turtles include the international trade in tortoise shells, egg collection, slaughter for meat, destruction of nesting and foraging habitat, marine litter and oil pollution (Mortimer & Donnelly, 2008; Seminoff, 2004).

4.2.2. Wildlife watching and interactions

Wildlife watching depends on the cetacean and bird species. Pan-tropical spotted dolphins (*Stenella attenuata*) are present year round and are the most numerous species recorded in St Helena's waters (Clingham, Henry & Beard, 2013; MacLeod & Bennett, 2007). Bottlenose dolphins (*Tursiops truncatus*) and rough-toothed dolphins (*Steno bredanensis*) are also resident in St Helena's waters occurring in mixed groups (Clingham, Henry & Beard, 2013; MacLeod & Bennett, 2007). Pan-tropical spotted dolphins (*Stenella attenuata*) are a subspecies of cetaceans associated with the high seas and oceanic islands. These species feed mainly on small epi- and mesopelagic fishes, squids, and crustaceans, flying fish are also believed to be an important prey species (Hammond et al., 2012b). The population of Pan-tropical spotted dolphins (*Stenella attenuata*) in St Helena's waters are a regional population of which the conservation status has not been assessed. Bottlenose dolphins have a similar dietary range to Pan-tropical spotted dolphins. Many coastal populations of bottlenose dolphins (*Tursiops truncatus*) have a limited range and oceanic bottlenose dolphin populations maintain, long-term multi-generational home ranges (Hammond et al., 2012a). Globally the populations of Pan-tropical spotted dolphins (*Stenella attenuata*) and Bottlenose dolphins (*Tursiops truncatus*) are impacted upon by the industrial fisheries as they are often caught as by-catch and sometimes deliberately targeted for human consumption (Hammond et al., 2012b; Hammond et al., 2012a).

Humpback whales (*Megaptera novaeangliae*) are a highly migratory species, undertaking long migrations between breeding grounds and feeding grounds. These species are sighted in St

St Helena's waters during the winter months. Most sightings are of single animals or adults with calves (MacLeod & Bennett, 2007). It is thought that this species may visit the water of St Helena, utilizing the sheltered areas for breeding and calving (MacLeod & Bennett, 2007). Due to the distance of this species to other known breeding/calving grounds it is possible that this population is an isolated breeding population, much depleted by the past commercial whaling efforts in the wider region (Clingham, Henry & Beard, 2013; MacLeod & Bennett, 2007). Following a period of intensive commercial whaling, this species has proved to be resilient with global populations believed to be increasing (Reilly et al., 2008). Impact from commercial fishing remains as a pressure on these species as they occasionally are entangled in fishing gear, there are also political moves by some countries to resume commercial whaling (Reilly et al., 2008).

There are eight species of seabird that breed on the cliffs and offshore islands of St Helena, Sooty terns (*Onychoprion fuscatus*), Fairy terns (*Gygis alba*), Red-billed tropicbirds (*Phaethon aethereus*), Brown noddies (*Anous stolidus*), Black noddies (*Anous minutus*), Brown boobies (*Sula leucogaster*), Masked boobies (*Sula dactylatra*) and, Madeiran storm petrels (*Oceanodroma castro*). Some species prefer the steep slopes and cliffs e.g. Red-billed tropicbirds (*Phaethon aethereus*), others will make use of open ground e.g. Fairy terns (*Gygis alba*) (Beard, Clingham & Henry, 2013). All breeding areas are vulnerable to noise disturbance, the birds that breed on open ground are vulnerable to physical disturbance e.g. human interactions and predation e.g. cats and rats. The diet of many of these bird species include fish and squid. Bird species make use of upwelling areas to forage. Several of these species are reliant on the feeding activities of predatory fish e.g. tuna (*Scombridae*), as they drive prey to the surface (BirdLife International, 2016). This can make some species vulnerable to fishing pressures as they are caught as by-catch. Changes in sea surface temperature can negatively affect the foraging success of some breeding colonies (Carol & Bradley, 2007).

Whale sharks (*Rhincodon typus*) are recorded in St Helena's waters from November to May with large aggregations reported in January (St Helena Government, 2016). Whale sharks (*Rhincodon typus*) are a highly mobile species though many are believed to show a high degree of site fidelity (Pierce & Norman, 2016). These species spend much of their time feeding in the epipelagic zone, whale shark sightings occur mainly at coastal feeding locations where the sharks aggregate in the surface waters to exploit seasonal productivity events such as plankton blooms and fish spawning (Rowat & Brooks, 2012). Whale sharks are predominantly filter feeders, filtering large volumes of water to extract plankton (Rowat & Brooks, 2012). They have been observed feeding on pelagic invertebrates, eggs released by spawning fish and small schooling fishes (sometimes driven into tight aggregations by predatory fish e.g. tuna (*Scombridae*)) (Rowat & Brooks, 2012). Current threats to this species include fisheries by-catch, commercial catch and vessel strikes. Tourism is considered to be an indirect threat through disturbance (crowding, harassment) along with coastal development (pollution and oil spills) (Pierce & Norman, 2016). Behavioral responses to physical disturbance include banking, rapid diving and avoidance which can disrupt feeding activity (Norman, B, 2002). This can, in turn, impact upon breeding and displacement, causing stress, injury or mortality (Norman, B, 2002). Cyclical or long-term climate shifts can affect whale shark occurrence and abundance (Sequeira et al., 2012).

4.3. Management

The St Helena Marine Management Plan summarizes the following regulations and management strategies for recreation activities. Recreation activities can operate within the whole EFZ though a number of restrictions apply:

- No dolphin, or spiny or slipper lobster in berry, to be taken within the entire EFZ (linked to environmental protection ordinance);
- No fishing is permitted without a license from St Helena Government and fishing activities are regulated via the licensing criteria (Linked to Fishery Limits Ordinance 2011);
- Targeted fishing for all species of shark (including shark finning) is banned throughout the entire EFZ (Linked to Environmental Protection Ordinance 2014);
- No use of droppers during the spawning season (January to March) for all inshore species of ground fish (it is permissible to use for bait fishing). This applies to rock fishing and boat fishing;
- All recreational (on boats) and commercial (tourism and fisheries) fishermen must adhere to catch limits and size restrictions as per their fishing licence;
- Traditional rock fishing is permitted for non-commercial purposes;
- Disposal of plastics, fishing materials including hooks and inorganic waste is prohibited throughout the entire EFZ;
- It is prohibited to interact with whale sharks, cetaceans or devil rays unless complying with the “Environmental policy for whale shark (*Rhincodon typus*), Devil Ray (*Mobula tarapacana*) and cetacean interaction activities on St. Helena Island to minimise risk of injury and disturbance; and
- Marine Tourism will be regulated via a licence with an accreditation system in place for MTOs (St Helena Government, 2016).

4.4. Data

Data on the economic value of the MTOs were gathered using a questionnaire designed to elicit a range of information on the number of people including (tourists and residents) taking part in a recreation activity and the expenditure on that activity. (Appendix II). Questionnaire data were analysed using Microsoft Excel. All values are presented in an aggregated format and are calculated from approximate values provided by the MTOs either as: charge per boat per day x number of trips per year; or (the number of trips per year x average number of people per trip) x cost per person. All values represent turnover and not profit.

To assess the levels of cultural and spiritual interactions with the marine environment where there is minimal economic expenditure, a survey conducted in 2014 by EMD a total of 124 adults asked about the type and frequency of their use of the marine environment around St. Helena (72% of those surveyed were Saints). Along with taking part in recreation activities many participants in the survey also stated that their main interaction with the sea was ‘spiritual which involves ‘Looking at the sea’ and use the sea as a source of ‘inspiration’. From the data it is possible to extract the frequency of recreation activity and the approximate number of trips per year (n=121), indicating a level (very high frequency, high frequency, medium frequency and low frequency) of cultural and spiritual value.

4.5. Results

As of March 2016, there are 4 MTOs in St Helena, Into the Blue, Sub Tropic Adventures, Enchanted Isle and Bedwell Enterprises. Between these MTOs nine boats were reported as ‘in use’ during the year 2015-2016:

- Tango
- Egalite
- Starlight
- Wildcat
- Sea Hawk
- Sea Horse
- Enchanted Isle
- Gannet 3
- Jubilie.

These enterprises support approximately 7 full time and 7 part time jobs. In the last 3 years these MTOs have invested approximately £159,000 in their businesses.

4.5.1.Valuation

Recreation activity generates approximately £214,000 in expenditure each year (Table 7). Wildlife Interactions, which comprise predominantly of viewing or snorkeling with whale sharks (*Rhincodon typus*), are the most popular trips (Table 7). Given the short season of 4 months this represents an intensive period for economic activity for the MTOs. Scuba diving activity, which takes place almost all year round, though more frequently in the summer months, is the most high value recreation activity generating approximately £88,618 in expenditure per year (Table 7). MTOs who predominately provide diving services report that approximately three quarters of their income is derived from the expenditure of local contractors (non-locals who live and work on the island) and tourists. No information was made available on the contribution of retail sales (diving kit) to MTO income.

Table 7 Expenditure on Recreation Activities (residents and tourists).

Recreation Activity	Approximate number of trips per year ^a	Approximate number of people taken on trips per year ^a	Cost range per trip ^a	Value 2015/2016 ^b
Scuba Diving	270	3286	£15-20 per dive £220-450 per dive training course	£88,618
Sport Fishing	52	252	£200-£250 per boat charter	£10,900
Wildlife Interactions	311	4009	£5-10 per person	£58,645
Wildlife Watching	199	2037	£10-£15 per person to £140-£200 per charter	£40,645
Scenic trips and island drop off/pick up	149	746	£5-£15 per person	£15,240
^a MTOs combined 2015/2016				
^b Calculated from price per trip provided by individual operators to provide a more accurate valuation				

4.5.2.Frequency of activity

For those activities where there are no valuation data available the spiritual associations with the marine environment 'Looking at the sea' and using the sea as a source of 'inspiration' are by far the most high frequency interactions with the marine environment, with respondents (n=121) predominately reporting that these are daily and weekly interactions (Table 8). Spending a day by the sea and swimming are the most popular (high frequency) recreational activities for contractors and permanent residents alike (Table 8). Recreational fishing (rocks and boat) and snorkeling are also popular activities. All respondents to the questionnaire (n=121) reported that they undertook a recreation activity that is associated with the marine environment. If this result is scaled up to the entire population of St Helena (approximately 4000) then it could be considered that every resident on St Helena interacts with the marine environment for recreation. There will be numerous and unquantifiable health and wellbeing benefits associated with these activities.

Table 8 Frequency of cultural and spiritual recreation activity for residents of St Helena separated as permanent residents and contractors (foreigners with employment contracts)

	Reported Frequency						Number of reported trips per year		
	Daily	Once a week	Once a month	Once every three months	Once every 6 months	Once a year	Contractor (n=31)	Permanent resident (n=90)	Total n=(121)
Fishing - rocks		7	6	15	5	20	79	429	508
Fishing - boat		4	8	17	2	8	180	160	340
Water sports		1	1	6	3	3		87	87
Sailing		3	7	9		3	123	42	165
Swimming	1	13	26	21	2	4	361	1059	1420
Spearfish			5	4		2	13	53	66
Day by sea	2	13	22	26	3	6	404	1404	1808
Snorkelling		7	12	15	1	4	254	276	530
Inspiration	14	18	7	6	1	1	2533	3379	5912
Looking at the Sea	37	31	7	6			3937	10931	14868

Key

	Very high frequency
	High frequency
	Medium frequency
	Low frequency

5. Tourism

5.1. Overview

Tourism has been identified as being a key driver for the future economic development of St Helena (St Helena Government, 2012). Tourism in St Helena is founded on the cultural and natural assets. The three pillars of tourism marketing on St. Helena are:

- Adventure;
- Nature /natural beauty (including marine); and
- Heritage and culture (St Helena Government, 2015).

At present tourists arrive on St. Helena via the Royal Mail Ship (RMS) St Helena, private yacht, and cruise and passenger ships where they pass through customs and immigration at Jamestown. After an initial landing fee charge, once on the island tourists then go on spend money on accommodation, food, excursions etc. Many visitors arriving on the RMS St Helena will stay on the island for the duration that it takes the RMS to return on its circuit from either Ascension Island or Cape Town. The marine environment is the currently the only access route to St Helena. A perception that the marine environment is beautiful and 'healthy' is part of the draw that brings tourists to the Island.

5.2. Critical pathways

Tourism is partly dependent on the same natural assets identified as the commercial, recreation and cultural ecosystem services. Particularly if people visit the island as 'experience' tourists, visitors who have a 'bucket list' of things they want to experience in life e.g. to swim with whale sharks. More broadly tourism in St Helena relies on something less tangible, a perception or knowledge that the tourist is visiting somewhere with natural beauty, of which the marine environment is part of the package. Pressures on this perceptual knowledge are largely visible e.g. litter and pollution. The value of the experience to the tourist can be determined by factors such as crowds, noise and levels of service (including safety).

5.3. Data

Data on tourism were made available via the Statistics Office which is part of the Corporate Policy and Planning Unit (CPPU) of the St Helena Government. Data is collected by the statistics office on:

- Number of cruise passengers;
- Total yacht vessels;
- Total yacht passengers;
- Total transit passengers (arrive and leave on the same call of the RMS St Helena); and
- Total tourist passengers.

The expenditure of tourists on St Helena was calculated in the following format (Table 9) as per the State of the Island Report (St Helena Government, 2015). Data on the numbers of vessels carrying passengers to St Helena was made available by the Port Management Department of St Helena Government. Data were separated into ships that carry passengers only (cruise and passenger ships) and ships that carry passengers and cargo to the island. Data for the jobs supported by the tourist industry were provided by the St Helena Tourist Office.

Table 9 Calculation formats for the expenditure of tourists on St Helena

Tourist group	Calculation
Cruise Ships	(No. of Persons * Landing Fee) + (No. of Persons * Estimated Spend)+ Cruise and passenger fee vessel ¹ (harbour dues and pratique)
Yachts	Yacht Fee ² (Light dues + mooring x average length of stay) + Person Spend (number x daily spend x average length of stay) + (permit fee and additional spend for those here >72 hours)
Transits	Person Spend (number x daily spend x average length of stay)+ (1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * stay on Ship transit fee)
Tourists	(No. of Persons * Landing Fee & Estimated Spend)+ (1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * Avg Spend on SC Acc * Avg length of Stay)
¹ Data on the harbour dues and pratique was made available from the Port Management Department of St Helena Government ships register. ² The St Helena State of the Island report does not include the Yacht fee as this is paid directly to the Harbour office. It is included here as an expenditure that is linked to tourism.	

5.4. Results

5.4.1. Passenger numbers

Total arrivals in the island have increased over the last seven years with approximately 4146 tourists per year based on 2014/2015 values (Table 10). The arrivals to St Helena comprise of a number of groups. There has been a marked increase of arrivals from cruise ships over the last seven years (Table 10). Numbers of visiting yachts have remained more consistent (Table 10). There are also an increasing number of people who come to visit friends and family on St Helena. Although their motivation for visiting is different to conventional tourists, once on the island they tend to stay for longer, engage in recreational activities and tours, but do not typically stay in catered accommodation (St Helena Government, 2015).

Table 10 Passenger Numbers arriving on St Helena between 2008 and 2015

Tourism	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Cruise Passengers	381	3,552	1,541	1,690	975	2,848	2,633
Cruise and Passenger Ships			33	33	40	52	19
Total Yacht Vessels				207	230	198	178
Total Yacht Passengers - of which stay longer than three days	711	490	646	628	725	624	621
Total Transit Passengers	29	27	7	44	78	67	138
Total Tourist Passengers	401	861	1,053	709	639	777	754
Total	1522	4930	3247	3071	2417	4316	4146

5.4.2.Expenditure

Tourism is estimated to have contributed £0.8m to the St. Helena economy in 2014/15 (Table 11). Tourists who arrive on the RMS St Helena and stay until the next call of the ship represent the greatest value sector. Caution must exercise when comparing the expenditure linked to tourism as calculated here and the expenditure on marine recreation activities detailed in the previous section as the estimated spend per day calculated by the St Helena Government does not state whether the daily spend also includes payment for marine based excursions or activities which would lead to double counting of the economic benefits from recreation activities.

Table 11 Tourism Expenditure

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	Time series average	SD (+/-)
Cruise and Passenger Ships ^a	£12,192	£122,426	£58,304	£64,464	£40,336	£121,528	£113,025	£76,039	£43,567
Yacht ^b	£44,082	£32,615	£44,746	£45,925	£54,852	£87,153	£104,357	£59,104	£26,331
Transit ^c	£5,583	£5,543	£1,476	£10,086	£18,525	£16,402	£34,666	£13,183	£11,278
Tourist ^d	£246,179	£565,468	£725,213	£520,544	£488,349	£604,859	£601,754	£536,052	£148,459
Total	£308,036	£726,051	£829,739	£641,019	£602,061	££829,941	£853,801	£684,378	£192,808

^a (No. of Persons * Landing Fee) + (No. of Persons * Estimated Spend)+ Cruise and passenger fee vessel¹ (harbour dues and pratique)

^b Yacht Fee² (Light dues + mooring x average length of stay) + Person Spend (number x daily spend x average length of stay) + (permit fee and additional spend for those here >72 hours)

^c Person Spend (number x daily spend x average length of stay)+ (1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * stay on Ship transit fee)

^d (No. of Persons * Landing Fee & Estimated Spend)+(1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) +(2/3 Persons * Avg Spend on SC Acc * Avg length of Stay)

5.4.3.Jobs

Tourism currently supports 146 full time jobs and 63 part time jobs in the supporting industry (Table 12).

Table 12 Jobs in the Tourism Sector

Sector	
Accommodation	42 FT jobs and 11 PT jobs.
Tour operators ¹	23 FT jobs and 5 PT jobs
Eateries	47 FT jobs and 25 PT jobs
Transport	34 FT jobs and 22 PT jobs
¹ Includes all tour operators. MTOs are included in more detail in the recreation section. All data provided by the Saint Helena Tourist Office	

6. Discussion

Table 13 provides a summary of the ecosystem service indicators for which there were data available to make a baseline assessment, along with an interpretation of how that indicator has changed recently over the time. This interpretation is either based on time series data where available or local/expert opinion. The most up to date figures are presented.

6.1. Fisheries

The first sale (wet weight) value of landings on St Helena is £198,157. This currently supports 34 employment opportunities (full time and part time). Fisheries are currently a picture of decline (Table 13) though the long term picture of landings (Annex IV) reveals that the fishery is highly variable across years. In the time frame for which valuation data was available local sales appear to have increased. From an ecological perspective stocks of the main target species (tunas) are managed regionally by ICCAT who set quotas (for some species) to maintain the resource at sustainable levels. Abundances of tuna species, schooling in St Helena's waters, can be highly variable across years making the ability to catch the allocated quota also variable. Overall tuna fisheries are vulnerable to Illegal, Unreported and Unregulated (IUU) fishing and the persistent effects of climate change which can influence migration patterns, feeding and reproductive success.

Recorded landings of species associated with the inshore waters have also declined (Table 13). It is unknown if these declines are associated with ecological pressures or if a change in the landing requirements (that requires all fish to be offered for first sale through the SHFC) and the closure of the wet fish market have meant that more fish are traded through the black market. It may also be possible that fishermen have taken alternative employment with the jobs created through the construction of the new airport. There has been concern locally about the abundance of Grouper (*Epinephelus adscensionis*). The local quota allowance is under consideration for review.

Currently the local sales (frozen, vacuum packed products) are sufficient to support the landings, so the direct payment to fishermen is secure. It is unlikely that the local sales also cover a proportionate cost of the operations of the fish processing factory that serves both the local and export market. Unless fish are caught and retained for subsistence purposes, there is no availability of sales of fresh fish. The recent export sales value is unlikely to support the scale of the fish processing enterprise.

There seems to be flexibility in employment in the fishing sector (on-board boats) with the majority of fishermen operating part time. It would be useful to determine if the fishermen need to seek alternative work to achieve a living wage or if the part time fishing employment is sufficient.

6.2. Recreation, cultural and spiritual ecosystem service benefits

Recreation opportunities via the MTOs generate approximately £214,048 per annum (Table 13). There has been clear growth in this sector (including jobs) over the last 5 years. MTOs within the sector are increasing capacity as demand increases. Scuba diving is the most high value recreation activity, taking place throughout the year. Wildlife interactions, particularly snorkeling and viewing whale sharks (*Rhincodon typus*) represent a short but high value seasonal income. The values of these recreation activities are largely dependent upon the expenditure of visitors (tourists) and contractors. These activities are totally dependent on the presence of marine species which may be vulnerable to physical impact and/or noise disturbance. All activities are largely dependent on the quality of the experience e.g. undamaged dive sites and number of divers in the water. Commercial fish species are also targeted by recreational

fishermen. As the recreation sector grows it will be imperative to manage recreational fisheries in line with commercial fisheries. Some species have a potential high value for sport fishing e.g. shark species may exceed the conventional commercial wet weight value (Gallagher & Hammerschlag, 2011).

The most popular recreation activities, those are associated with the local culture, include a 'day out by the sea' and 'swimming'. There is a spiritual element to recreation activities that include simply 'looking at the sea' and gaining 'inspiration' from the sea. Local residents reported a 'very high' frequency of activity associated with these activities. It must be considered that these interactions are invaluable as there is no means by which to accurately reflect the numerous health and wellbeing benefits of the interactions with the blue environment (Depledge & Bird, 2009; Wheeler *et al.*, 2012). Direct recreation activity (e.g. scuba diving) is dependent upon the quality of the marine environment. Indirect recreation activities such as 'looking at the sea' are dependent upon a positive perception of the marine environment.

6.3. Tourism

Tourism is an ecosystem service benefit which creates approximately £0.8million per annum in expenditure (Table 13). Over the last 12 months there has been an international marketing campaign to promote tourism in St. Helena, which specifically includes a marine component focused on whale shark season (Jan-March approx.). 'Tourist passengers' those who take an extended stay on the island whilst the RMS St Helena continues to the next port represent the highest value tourist group. Like recreation activities, tourists will be drawn to the island based on a positive perception of the marine environment and the opportunity to potentially take part in some direct recreation activities such as scenic trips. There are an increasing number of jobs in the tourism sector on St Helena (accommodation, transport, food and excursions). Similar to the requirements of spiritual ecosystem services the delivery of this dependent on a positive knowledge or perception of the marine environment.

Table 13 Summary table of ecosystem service indicators and associated monetary and non-monetary valuation metrics. The time series trend shows if the data series has been positive (+), negative (-) or remained stable over time (+/-) for which data were available

Beneficial ecosystem service	Indicator		Valuation metric	Time Series trend
Fisheries	Total	Value (£)	£198,157^a	-
	Fishing vessels	Number	12	+/-
	Landings	Weight (kg)	251,572	-
		Purchase Value (£)	£152,000	-
	Sales	SHFC (£)	£25,157	-
		Local (kg)	68,720	+
		Local (£)	£179,000	+
		Export (kg)	116,000	-
		Export (£)	£146,000	-
	Jobs	At sea	34	+/-
		Processing	25	Currently downsizing
Recreation and Culture	Total	Value (£)	£214,048^b	+
	MTOs	Number of operators	4	+
		In-use vessels	9	+
	Jobs	At sea and on land	7FT/7PT	+
	Scuba Diving	Trips per year	270	+
		Number of people on trips	3286	+
		Value (£)	£88,618	+
	Sport Fishing	Trips per year	52	+
		Number of people on trips	252	+
		Value (£)	£10,900	+
	Wildlife Interactions	Trips per year	311	+
		Number of people on trips	4009	+
		Value (£)	£58,645	+
	Wildlife Watching	Trips per year	199	+
		Number of people on trips	2037	+
		Value (£)	£40,645	+
	Scenic trips and island drop off/pick up	Trips per year	149	+
		Number of people on trips	746	+
		Value (£)	£15,240	+

Beneficial ecosystem service	Indicator		Valuation metric	Time Series trend
Cultural	Fishing - rocks	Reported frequency of activity	Medium	No data available
	Fishing - boat	Reported frequency of activity	Medium	No data available
	Water sports	Reported frequency of activity	Low	No data available
	Sailing	Reported frequency of activity	Low	No data available
	Swimming	Reported frequency of activity	High	No data available
	Spearfish	Reported frequency of activity	Low	No data available
	Day by sea	Reported frequency of activity	High	No data available
	Snorkelling	Reported frequency of activity	Low	No data available
Spiritual	Inspiration	Reported frequency of activity	Very High	No data available
	Looking at the Sea	Reported frequency of activity	Very high	No data available
Tourism	Total	Value (£)	£853,802^c	+
	Cruise	Passenger numbers	2,633	+
	Cruise and Passenger Ships	Number	19	-
		Expenditure (£)	£113,025 ^{c1}	+/-
	Yachts	Number of vessels	178	+/-
		Number of Passengers	621	+/-
		Number of Passengers (stay longer than 3 days)	327	+/-
		Expenditure (£)	£104,357 ^{c2}	+
	Transit passengers	Number	138	+
		Expenditure (£)	£34,666 ^{c3}	+
	Tourist passengers	Number	754	+
		Expenditure (£)	£601,754 ^{c4}	+
	Jobs	Numbers employed in supporting sectors	146FT/63PT	

^a Total value from sales minus purchases.

^b The combined monetary value of each recreation activity. All values are presented in an aggregated format and are calculated from approximate values provided by the MTOs either as: charge per boat per day x number of trips per year; or (the number of trips per year x average number of people per trip) x cost per person. All values represent turnover and not profit.

^c The combined value of expenditure across each of the tourism groups e.g. yachts, cruise and passenger ships. There may be double counting of values with recreation and cultural as the 'daily spend' may include trips taken with the MTOs.

^{c1}(No. of Persons * Landing Fee) + (No. of Persons * Estimated Spend)+ Cruise and passenger fee vessel¹ (harbour dues and pratique)

^{c2} Yacht Fee² (Light dues + mooring x average length of stay) + Person Spend (number x daily spend x average length of stay) + (permit fee and additional spend for those here >72 hours)

^{c3} Person Spend (number x daily spend x average length of stay)+ (1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) + (2/3 Persons * stay on Ship transit fee)

^{c4}(No. of Persons * Landing Fee & Estimated Spend)+(1/3 Persons * Avg Spend Hotel Acc * Avg Length of Stay) +(2/3 Persons * Avg Spend on SC Acc * Avg length of Stay)

7. Future Development Thresholds and Management

7.1. The “extreme future” scenario

Workshop participants were asked to envisage two future scenarios i) extreme commercial fishing and ii) extreme recreation and tourism. The purpose of the workshop exercise was to create a vision of an undesired future for the use of the marine resources of St Helena. This vision represents a scenario where the workshop participants consider that a threshold has been crossed and activities become unsustainable (Table 14).

Table 14 The “extreme future” scenario as described by workshop participants

Service / benefit	A vision of the extreme
Commercial fishing	<ul style="list-style-type: none">• Overfishing and inappropriate fishing have destroyed the fish stocks and ecology• There is no development of fisheries markets, no more money to fishermen and industry collapse.• No fresh fish are readily available for the local market.• There is a large amount of waste (discards and rubbish) in the marine environment.• There are obvious impacts on non-target species.• Overfishing causes collapse in commercial stocks.• Key commercial stocks are depleted.• No fish is available for local consumption.• Local fishermen have no means to make a livelihood.
Extreme recreation and tourism	<ul style="list-style-type: none">• Spear fishing is unregulated.• Key habitat and species have been destroyed.• Jet ski numbers are unlimited.• There are so many tourists that whale sharks and humpback whales stay away.• Dive sites are damaged by careless divers.• Dive sites are crowded, the natural experience is ruined.• There is a decrease in the numbers of migratory marine mammals visiting St Helena.• There have been accidents at sea and on the wharf (e.g. collisions, fuel spills).• Tourists are pushing out locals from traditional recreation activities by virtue of their numbers.• The seafront is overwhelmed by huge numbers of people.• The wharf and St James Bay are over-crowded, dirty, and covered in litter.• Wildlife interactions are overcrowded, too many boats viewing whale sharks, whales, dolphins and birds.• Fish stocks are overexploited.• Recreational activities (e.g. sports fishing) are more important than commercial fishing

7.2. Thresholds for sustainable use

Workshop participants and the MTO interviewees were asked to identify any thresholds (red flags) and/or any indicators that the development of the commercial fisheries and tourism (including recreation) are approaching the 'extreme' thresholds and therefore threatening the associated values.

Table 15 provides a list of the thresholds identified along with an evaluation of whether the threshold has been already been exceeded. It can be seen that a there are a number of thresholds that have been exceeded requiring urgent management intervention. There are also a number of thresholds which have not been exceeded and management strategies are in place or close to being implemented.

Table 15 Thresholds for sustainable use identified as 'red flags' by workshop participants and upon review of available data whether these thresholds have already been exceeded (Y), not exceeded (N) or there is no data available by which to assess the status of the threshold (?).

Thresholds	Threshold status	Comments
Decline in landings of grouper	Y	Landings have declined. There is a current quota for grouper of 36 tonnes per year though this is considered to be too high. There is no current knowledge of recreational (subsistence) or black market sales of this species.
Decline in landings of longfin and skipjack	Y	Stock management is under the control of ICAAT. Catch limits apply to St Helena flagged vessels.
An increased in reported marine accidents.	?	Workshop participants were concerned that crowding on the wharf and the increasing popularity of water sports means that there will more accidents. Safety issues lined to tourism and recreation may devalue St Helena as a tourist destination. It may be possible to record data from marine accidents and near misses from Port control.
A decline in economic values associated with fisheries	Y	Overall landings have declined. The export market is largely unprofitable at this point in time.
A decline in economic values associated with recreation	N	The majority of these values have increased. Data is not annually collected on numbers of visitors, charges and number of trips.

Thresholds	Threshold status	Comments
A decline in economic values associated with tourism	N	The majority of these values have increased. Statistics on tourist numbers are annually collated through the Government statistics office. The number of jobs supported by the tourism sector is collated by the Tourist Office.
An increase in the deployment of Floating Aggregating Devices (FADs) by recreational fishermen	?	<p>An increase in FADs is often associated with IUU fishing and/or an intensification of a fishery. Unreported fishing will place pressure on existing stocks and undermine the associated value/jobs.</p> <p>Any new FAD deployment will be subject to management policy from ANRD.</p>
An increase in sales of fish through the black market	Y	<p>There is currently no fresh fish market on St Helena. It must be assumed that beyond subsistence fishing they may be a recent increase in black market fish sales.</p> <p>Unreported fishing will place pressure on existing stocks and undermine the associated value/jobs.</p>
Dead areas of the sea related to sewage and nutrients	?	There is virtually no sewage treatment on the island. Impact areas are likely to be directly near sewerage outfalls or seep pathways into the marine environment. There is no formal water quality monitoring programme though work has commenced to improve sewerage treatment facilities on the Island. Dead areas and visible sewage will undermine the positive perception and knowledge associations that support tourism and spiritual ecosystem services.
Decline in numbers of endemic species	N	Key sites are monitored biannually for abundance and biomass.
Damaged dive sites	?	Aside from reports of damage to sites from divers there is no means to confidently assess slow and long term change to dive sites as no control areas have been established from which to observe a non impacted state. It must be assumed that as the growth in this sport has increased that some diver damage has been incurred at popular dive sites. This will undermine the ecosystem service value associated with scuba diving as a recreational ecosystem service. A new MTO accreditation scheme may promote good environmental practice. There are proposals for fixed moorings at popular dive sites.

Thresholds	Threshold status	Comments
Overfished sites	?	Not currently monitored
Persistent disturbance to vulnerable species	N	Bird counts are undertaken by EMD. MTO have a Code of Conduct that applies to operations in the vicinity of all marine species. There are no observations of behavioral responses of whale shark or whale interactions which may undermine the ecosystem service value associated with whale shark tourism
Poor feedback on social media (eg. trip advisor) on recreation and tourism experiences.	?	Not currently monitored
Wildlife watching experiences are overcrowded	N	4-5 boats are considered by MTOs to be a sustainable number to avoid overcrowding and to not place constant pressure on the resource. There is a code of conduct from MTOs in place to allow fair and equal access to the resource. It would be useful to understand perceptions of overcrowding from the perspective of the customer.

7.3. The “desired future” scenario

Workshop participants identified a vision for the future whereby:

- The marine environment is valued;
- Marine management is integrated, effective with sufficient operational capacity and resources;
- The natural environment is managed holistically;
- Stock management (commercial and recreational) is underpinned by robust science;
- Recreation activities are managed and monitored (species and habitats);
- There is a thriving export and local market in fish products
- Tourists are satisfied with their experience of the natural environment on St Helena; and
- Development is managed to support a quality over quantity product for both fisheries and tourism

The group identified a number of barriers and enablers (Figure 3) that are both within and outside of local control to achieve this future aim. These are discussed in more detail below.

7.3.1. Fisheries

Outside of local control of fisheries management is the external pressure of climate change which is exerting broadscale changes on levels of biodiversity, trophic structures, and food webs and is believed to be influencing ocean currents. Workshop participants recognise the need for improved assessments of other commercial stocks (e.g. grouper, *Epinephelus adscensionis*), along with an assessment of the ‘bait fish’ which support the wider fishery. An enabler towards the future vision, but which is also considered to be outside of local control, is the tuna fishing quota set by ICAAT. St Helena government representatives do have a voice at the ICCAT meetings. It is unclear though if there is capacity within the local fleet to land higher volumes of fish.

IUU fishing is also considered to be outside of local control. At present, there is a reliance on vessels at sea to act as a deterrent and report IUU fishing also to follow up on any vessels sighted through the AIS system. It is likely though that illegal vessels will not broadcast an AIS signal.

There are several enablers (across sectors) within local control to support fisheries. The new St Helena Marine Management Plan (2016) along with the remit of ANRD takes an integrated approach to marine resource use management through strategic spatial planning with legal instruments (fishing licenses) and technical restrictions (e.g. pole and line fishing only, a limited number of longlines). The workshop participants noted that beyond this, the “desired future” for fisheries could be enabled by an additional requirement for commercial operators to report catches using a log book system. It is considered that log book completion should be a mandatory requirement for licensing.

In terms of the value of sales, whilst export market prices are not within local control, it is possible (and within local control) to seek a higher value for the current product. A business manager dedicated to seeking new markets could facilitate this process. The reinstatement of a wet fish market would reduce the unregulated black fish market and provide a means for adding additional value to fish products sold locally. Additionally the provision of facilities to ice fish on a Sunday may improve the reporting of landings (recreation and commercial).

Figure 3 Barrier and enablers both within and outside of local control identified by workshop participants to achieve the desired future vision for sustainable development of marine fisheries, tourism and recreation on St Helena.

Enabler outside of control	Enabler within control
<p>Fisheries ICCAT quota IUU Fishing</p>	<p>Fisheries Fishermen filling in log books to report catches A business manager to improve export market A wet fish market Stock assessments</p> <p>Recreation and Tourism MTOs filling out log books to report on number of trips and visitors. MTO accreditation scheme. Annual monitoring of sites. Local operators need insurance and an easier means of getting insurance Licenses for water craft (e.g. jet ski) Licenses for recreational fishermen. Education for water craft users. Port management to regulate water sports Licenses for water craft (e.g. jet ski)</p> <p>General St Helena Marine Management Plan A broad scale assessment of bait fish (regional scale) Funding for an enforcement officer</p>
Barriers outside control	Barriers within control
<p>Fisheries Export price of fish</p> <p>General Climate change Ocean currents</p>	<p>General Need holistic, integrated planning and regulation. Combined port and fisheries management. A 10 year plan.</p>

7.3.2. Recreation and tourism

Climate change was again identified as a barrier that was outside of local control in terms of the influences that broadscale oceanic changes may have over migratory patterns, reproductive success and food availability of the species which are linked to the recreation and tourist industry. Including the development of the St Helena Marine Management Plan, within local control are a number of enablers to support the recreation and tourist industry (Figure 3). Management of the marine tourism sector is supported by the MTO accreditation scheme, where the voluntary code of conduct will help limit disturbance to marine species and habitats. The local tourist board has the means to direct tourists towards accredited MTOs and this may prevent non accredited MTOs from gaining access to the market. A requirement for MTOs to keep log book activities will help provide long term data on visitor numbers and trips. It is considered that log book completion should be a mandatory requirement for licensing.

Workshop participants recognised that managing the tourist and recreation industry within sustainable limits will require investment in baseline surveys and monitoring of: dive sites which will be vulnerable to damage; behavioral responses of key species to interactions (noise, water craft, swimmers); and levels of catch and mortality from rock fishing sites/recreational fishing activities. Experimental design and standardized data collection will be imperative to the assessment of the impact of activities. Additional research is needed on the plankton-zooplankton-bait fish chain whose life cycle influences the distribution of some of the key species associated with the recreation and tourism sector.

Workshop participants suggested the idea to have recreation ‘advocates’, (e.g. the local rock fishing champion), members of the St Helena community who are respected and fully informed about the environmental impacts and thresholds to work with key groups to support the sustainable development of recreation and tourism.

The expansion of recreational watersports (jet skis, kayaks, water skiing) is a key concern as it will increase pressure on key species (disturbance, physical damage), habitats (anchoring) and will facilitate a growth in recreational fishing (including spearfishing). Within local control is the means to implement a licensing system for water craft and recreational fishers. It is recognised that port management has a key role here along with considering aspects of maritime safety both at sea and at the main harbors.

Part of the future vision is that tourists leave St Helena with a positive memory of the natural (marine environment). Within local control is a means to collect such data at the Island exit points (air and sea).

7.3.3. General

A current barrier (within local control) to achieving the future vision is the lack of integration between port, environment and fisheries management. In order for marine management to be effective there is a need to share duties across the different organisations. Workshop participants considered that this is a barrier that is within local control and that integration across sectors could be developed as part of the overall 10 year plan currently being developed for St Helena. The development of a long term, integrated plan for St Helena would enable capacity and resource needs to be assessed. The employment of an enforcement officer, who could work across the sectors of inshore fisheries commercial and recreational and environment, was noted as a key capacity need.

8. Conclusions

The physical and biological components of marine environment of St Helena, interact to provide a series of ecosystem processes and functions that ultimately underpin the beneficial ecosystem services of fisheries, recreation and culture, spiritual; and tourism. These beneficial ecosystem services, in turn, support aspects of human wellbeing on St Helena in terms of providing a means of income, relaxation and food. These services are valuable. Directly attributable to the marine environment are fishing (commercial and recreational), scuba diving and wildlife watching/interactions.

The value of the fishing industry is highly variable across years. A number of thresholds that signal unsustainable development have been crossed. Most notably, a decline in economic values associated with this ecosystem service due to both ecological factors and market forces. The reinstatement of a local wet fish market which will provide the wide variety of fresh fish for the local market will support local sales, and underpin the direct value to local fishermen. Coupled with the development of the island economy from tourism there are opportunities for the expansion of the local market for fish and increased opportunities for high value fresh fish and value added fish products. An urgent review is required of the operations of the export market in terms of scale and current value achieved for products.

Tourism and recreation are currently the main growth areas with high values associated with seasonal wildlife watching trips. The most valuable recreation activities are directly associated with wildlife interactions e.g. scuba diving and swimming with whale sharks. Given the trend of global growth in ecotourism related to marine species, particularly whale sharks (*Rhincodon typus*) (Gallagher & Hammerschlag, 2011) there are clear opportunities for making the marine ecosystems and wildlife central to tourism development. The key focal species are vulnerable to disturbance therefore the number of interactions needs managed to avoid deleterious effects. If numbers are to be limited then the pricing of these activities needs to be considered by the MTOs against the wider global market in order to achieve a balance between income and the numbers of people interacting with the species. Sport fishing is also a high value market but is, as yet, undeveloped on St Helena. Underpinning some of these ecosystem services delivery e.g. the tuna fisheries is a chain of primary and secondary production, of which there is a limited knowledge of the drivers of spatial and temporal variations.

Tourism, recreation activities such as water sports and spiritual ecosystem services are more indirectly associated with the marine environment. Positive knowledge and perceptions of the marine environment are essential to maintain these values. Negative knowledge or perceptions about the marine environment for example health scares (e.g. illness from sewerage); safety issues (e.g. collisions at sea); collapse in fish stocks affecting food supply and; visual disturbance (e.g. litter) can undermine these values. Along with the development of the island's airport, future development in the tourism industry needs to consider the role of the cruise ship industry in increasing the economic value of tourism. There has been growth in the number of cruise ship visitors on the island in recent years. The cruise industry (as with any aspect of tourism that involves large volumes of tourists) is a resource dependent industry which has had a history, in some areas of the world, of associated pollution and unsustainable consumption of resources (Johnson, 2002; Wheeler, 1991). There is a need to understand the carrying capacity of the natural resource along with aspects of social responsibility to the residents of St Helena in the development of mass tourism.

There is a high level of awareness amongst St Helena stakeholders of the links between the marine environment and ecosystem service benefits realized by the local population. There is also a deep and spiritual connection to the sea that cannot be valued by conventional means and should therefore be considered as 'invaluable' in planning processes. Demonstrated though this process is a positive "desired future" for the marine environment, with the majority of means to

achieve this being within local control. The marine management plan that proposes to encompass the entire 200nm Exclusive Fisheries Zone (EFZ) as an MPA will, though the management measures proposed, provide a framework to underpin this value and ensure the foundations for sustainable economic growth. Additional suggestions made by the workshop participants to work towards further integrated management with other sectors e.g. ports and to consider more effective means of enforcement will strengthen and facilitate progress towards local goals along with broader ambitions for sustainable development.

9. Recommendations

Along with the ‘enablers within local control’ identified by local stakeholders the following are suggestions to further support sustainable economic development on St Helena.

9.1. Natural Capital Accounting

Traditional approaches to calculating Gross Domestic Product (GDP), which demonstrate the annual monetary value of goods and services produced by a country, do not take into account the natural capital (the ecosystems). Natural Capital Accounting has developed as a method to include the value of the physical environment e.g. the marine environment and the value of the ecosystem services e.g. recreation, fish into be included in the national accounting balance sheet. Any gains and losses in the natural capital can be monitored in relation to economic development. The UK National Ecosystem Assessment consider natural capital accounting to be a “foundational activity” which helps to create an appropriate scientific and institutional context within which governments and others can influence decisions affecting ecosystem management across society. The natural environmental features of St Helena are central to future economic growth. A formalized system of natural capital accounting, led by the local government, should be considered as essential to support this aim.

9.2. Performance Management

There is a need to understand changes that are associated with both the demand for ecosystem services and management interventions in order to determine whether management measures are effective or not. A range of socio-economic indicators were selected for this study which may be useful to determine the ‘performance’ of management interventions over time. It would be advisable at this stage of development of the recreation and tourist industry in St Helena to define some linked social-ecological ‘impact studies’ for key areas key areas of growth. For example:

1. Whale shark study to include monitoring of i) tourist numbers/time interactions; ii) the behavioral responses of whale sharks to human interactions; and iii) levels of compliance with the Code of Conduct; and vi) the whale shark economy
2. Dive tourism study to include monitoring of i) number of divers/dives; ii) behavior of divers/levels of compliance; iii) diver impact on ecology by establishing control sites and; iv) the scuba diving economy.
3. Ecosystem modelling of the plankton-zooplankton-bait fish chain whose life cycle influences the economic value of some of the key species associated with fisheries, recreation and tourism.

4. Recreation fishing study to include monitoring of: i) number of recreational fishermen; ii) behavior of fishermen/levels of compliance; iii) impact on ecological features by establishing control sites and; iii) the recreational fishing economy.

The selection and analysis of linked social and economic indicators will contribute to the development of a more detailed understanding of the social-ecological system as a whole that will lead to more informed management plans and a transparent decision making process.

9.3. Payment for Ecosystem Services (PES)

PES often involves a series of payments to natural resource managers (in this case EMD and ANRD) in return for a guaranteed flow of ecosystem services (or, more commonly, for management actions likely to enhance their provision). Payments are made by the beneficiaries of the services in question, for example, individuals, communities, businesses or government acting on behalf of various parties. Means to raise PES can be achieved through annual licence fees or tourist taxes for example. Maintaining and ensuring the future delivery of the beneficial ecosystem services requires investment in management and enforcement. Aside from funds centrally allocated for environmental management, PES can potentially provide a means to enhance this.

9.4. A Hub for Research Excellence

The marine waters of St Helena can be considered to be relatively un-impacted by human pressures due to the isolation of the island. Combined with the management measures proposed in the St Helena Marine Management Plan (2016) this provides an opportunity to study how management interventions can support the social-ecological system. The presence of the charismatic species (whale sharks, turtles, humpbacks), of which primary research is needed to support global conservation efforts, could be conducted from St Helena. Additionally, the unmapped ecology of the offshore seamounts provides opportunities for new discoveries. St Helena has already attracted research funding from external organisations. Making research excellence central to the broader sustainable development of the island economy is an opportunity to raise the profile of St Helena as a top class eco-tourism destination.

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11. Annex I

Questionnaire Marine Tour Operators

1. Business name:
2. Interviewee name:
3. How many years have you been running your business on St Helena?
4. Boat name(s)?

5. What services does your business provide? EMD break it down into wildlife interaction tours, wildlife viewing tours, dive tours. Courses or training, other services e.g. equipment hire.

Service	Proportion of business (100%)	Boat name	Average price for this service per trip or per course	Approximate number of people buying this service last year	OR Number of trips last year	Average number of people per trip.	Increase or decrease from previous year.
e.g Whale Shark Trip							
Other							

6. Client immigration status. What proportion of your customers are local, local contractor, or tourist and which are the most popular trips?

Local	Local Contractor	Tourist

7. How many staff were employed by your business last year (full-time)..... (part-time).....
8. Is this more or less than the previous year?

9. Please can you indicate your annual turnover either as a figure.....or within one of these bands

Turnover	
0-10000	
11000 -20000	
21000-30000	
31000-40000	
41000-50000	
51000-60000	
61000-70000	

71000-80000	
80000-90000	
91000 - 100000	
Other?	

10. Please could you indicate your operating costs as a percentage of your turnover?

Marine species

11. Please identify which species you purposefully target and if there are any 'pressures' you can identify at the site with may affect either the site or the target species.

Target species	Predominant habitat (e.g. reef, sand, open ocean, seamount or wreck)	Dependent upon e.g. food sources	Pressures	Evidence

.....
Open Question: What do you need to ensure that your business has a long term future?

12. Annex II

Workshop agenda

9am – Arrive

9:10 – Introduction from Liz (5min)

9:15 – 9:30 Validation of current knowledge of links between ecosystem and the ecosystem service benefits for species targeted by commercial fisheries and the recreation businesses **(story of the present)**.

9:30 – 9:50 – Developing the extreme **(story of an undesired future)**

A scenario is a coherent, internally consistent, and plausible description of a possible future state. Scenarios commonly are required in ecosystem service assessments to provide alternative views of future conditions considered likely to influence a given system or activity.

What would extreme fishing look like?

What would extreme tourism look like?

Identification of tipping points. What are the warning signals that we are approaching the extreme?

10:00 – 10:30 – Moving towards a desired future **(story of a desired future)**

- Describe a desired future
- Define the key differences between desired future and today.

10:30 – 11:00

- Identify drivers and trends, which could impact on your ability to achieve the desired future.
- Map the drivers and trends on a matrix according to whether they are barriers or enablers towards achieving the desired future; and whether they are in your control or out of your control.
- Discuss that needs to be done to ensure that barriers within your control are minimised and that enablers inside your control are optimised
- Explore how to get round barriers outside your control
- Define performance indicators map onto a timeline

End by 11:30 at the latest

13. Annex III

Beneficial ecosystem service	Description	Main targets species	Dependencies	Pressures (Workshop 1)	Indicator	Description	Value (2014/15)	Jobs	Looking forward (Workshop 1)
Fisheries	Fishing on St Helena is predominantly pole and line with fishermen mainly using <i>Decapterus sp</i> and <i>Scomber japonicas</i> as live and cut bait. Commercial fishing has an important contribution to the local diet; to local identity and; as a visual amenity of Jamestown harbour. Commercial fisheries support both a local and export market	The dominant commercial target species are the Tunas (grouped as yellowfin, bigeye and longfin), skipjack, wahoo and grouper. Also caught commercially are marlin, mackerel, conger, cavalley, bullseye, soldier, yellowtail, shark, dorado and file fish. There are occasional landings of slipper and spiny lobster caught by fishermen deploying pots.	There is currently a limited understanding of the reasons why migratory species travel through St Helena's waters, the duration of stay, or if any of the essential life history stages are supported here. Stock availability can be linked to factors such as food availability, enhanced productivity, ocean currents and mixing, and suitable thermal gradients.	Increased demand for local produce and export; Changes in prey species abundance; Climate change; IUU fishing; Legal fishing. Other ICAAT regulated fishing catching quota. Pollution and reduction in water quality; Natural changes in available fish stocks; Pollution from homes and boats affects bait catches for commercial fishing; Storm water discharge and nutrients in the sea; and Oil pollution (there are no facilities to deal with an oil spill).	Landings	1 st sale wet weight from SHFC to fishermen	£147,995 (25% FT (offshore; 37% FT inshore/offshore; 36% FT Inshore; 0.2%PT Inshore 6 year average = £178,057 (SD=+/- £87,079) *currently no values for operating costs e.g. fuel, bait/squeeze, ferry service etc.	36 Employment opportunities (FT and PT). Overestimate as crew swap between boats. St Helena Government Private Sector Employment Survey (2010) states that there were 18 jobs in the fishing industry, representing 12 FT jobs and 4 PT.	Improved stock assessment may generate better control on catches; Retention of key species (yellowfin). Increased population; generating increased demand for food; Increase in health benefits from more fish in diet (trend is not towards fast food); Increased prices available on world market due to better access and; Foreign licensing for fishing. Diversification into other gear type/fishing method?
					Sales SHFC	SHFC add 0.10p per kg landed before fish is processed for sale to the local and export market	£25,157 6 year ave= £38,337 (SD=+/- 24,608) Squeeze sales? Fuel sales?	Approximately 25 salaries, Currently downsizing to 19 jobs. Also covers overheads and premises.	

Beneficial ecosystem service	Description	Main targets species	Dependencies	Pressures (Workshop 1)	Indicator	Description	Value (2014/15)	Jobs	Looking forward (Workshop 1)
					Sales Local	Vacuum packed	£179,000 6 year ave= £152,057 (SD=+/-£16,659)		
					Sales Export	Tuna predominantly sold vacuum packed, dressed without tail and in-round (Skipjack).	£146,000 6 year ave= £282,940 (SD=+/- £299,576)		

Beneficial ecosystem service	Description	Main targets species	Dependencies	Pressures (Workshop 1)	Indicator	Description	Value (2014/2015)	Jobs 2015/2016	Looking forward (Workshop 1)
Tourism	Tourists arrive on St. Helena via the RMS St Helena, private yacht, and excursion or cruise ships.	The three pillars of tourism marketing on St. Helena are: Adventure; Nature /natural beauty (including marine) and; Heritage and culture. An assumption is made here that underpinning the revenue from tourism are those opportunities to spend time in a natural environment.	A healthy marine environment (perceived and actual) with something to see is part of the attraction of St Helena for Tourists	Increase in visitor numbers ;	Cruise	Calculated by the number of people paying landing fee and their estimated daily spend	£111,173 (n=2,633) 7 year ave=£74,140 (SD=+/-£43,495)	Accommodation: 42 FT jobs and 11 PT jobs. Tour operators (marine tour operators separated below in recreation): 23 FT jobs and 5 PT jobs. Eateries: 47 FT jobs and 25 PT jobs. Transport: 34 Fulltime jobs and 22 PT jobs.	Safety issues e.g. accidents at the wharf Positive economic development opportunities Increased opportunities for tour operators. Caps on tourist numbers (may support environmental protection but reduce financial opportunities) Tourism offer to be based on quality not quantity. Demand for a greater variety of water sports /marine based activities.
				Greater demand for marine tourism;					
				Spatial conflict between uses;	Yacht	Calculated by the Yacht fee (light dues, mooring, average length of stay) x person spend (number x daily spend x average length of stay; permit fee and additional spend for those here >72 hours	£97,059 (n=621 people and 178 vessels) 7 year ave=£56,902 (SD=+/- £22,837)		
				Disturbance of target species;					
				Degraded habitat due to overuse;					
				Crowding at sites;	Transit	Tourists who arrive and leave on the same call of ship. Calculated by person spend (number x daily spend x average length of stay. Accounting for visitors that spend on hotel accommodation Approx. 1/3 of transit visitors.	£34,666 (n=138) 7 year ave=££13,183 (SD=+/- £11,278)		
				Conflict between tourism activities and local uses and traditions;					
				Theft of natural ornaments and heritage items (e.g. from wrecks);					
				Sewerage discharge is increasing; and	Tourists	Calculated as transit + landing fee to cover stay here >72 hours.	£601,754 (n=754) 7 year ave=££536,052 SD=+/- £148,459		
				Risk from oil pollution					

Beneficial ecosystem service	Description	Main targets species	Dependencies	Pressures (same as tourism but specifically)	Indicator	Description	Value 2015/2016	Jobs	Looking Forward
Recreation and Culture	Tourists (including contractors) and locals alike take part in recreation activities that are associated with the marine environment. Many recreation activities are also cultural on St Helena these historical cultural recreation including rock fishing and boat fishing. Saints also take part in all recreation activities provided by the Marine Tour Operators either to take an annual trip out to see seasonal wildlife, to take part in a popular sport (diving), or to celebrate (scenic trips at sunset or for a party).	Diving: Endemic species, Devil Rays, Turtles	Endemic species require specific depth, temp, food availability. Turtles are migratory following food sources. Green turtles nest at Sandy Bay. Devil Rays are plankton eaters seeking out areas of high productivity.	Overcrowding, damaged sites esp. slow growing corals; Litter (turtles); sewerage, climate change	Diving, including dive training	All values are calculated from approximate values provided by the marine tour operators either as: Charge per boat per day x number of trips per year; or (the number of trips per year x average number of people per trip) x cost per person. All values represent turnover and not profit.	£88,618	Four businesses = 7 FT and 7 PT jobs	St Helena Dive Club may operate more of their own dives if tourism increases. Environmental accreditation scheme for marine tour operators New regulation which will mean that 2 fish can be landed per trip, rest catch and release. Strictness may encourage rule breaking. Need independent enforcement of environmental regulations Need a means of reporting Need better coordination with the Tourist Office. Spatial and temporal management of number of boats and visitors on wildlife watching trips. Safety at the wharf (port management)
		Sport Fishing: Tunas, Marlin, Grouper, Wahoo	Same as commercial fishing	Same as commercial fishing	Sport Fishing		£10,900		
		Whale Sharks (seasonal)	Whale sharks are plankton eaters following the food source and areas of enhanced productivity. Seasonal stay in St Helena may correspond with spawning of tunas, and local bait species.	Noise, crowds, boat strikes, food competition, climate change	Whale Shark trips		£58,645		
		Wildlife Watching: Birds, Dolphins, Humpback Whales (seasonal)	Pan tropical dolphins are resident requiring specific food availability and oceanic conditions. Humpback whales are thought to make use of the sheltered inlets and predator free waters to give birth. Birds require the protection of the coastal cliffs and islands.	Noise, crowds, boat strikes. Many humpbacks are here with young. Disturbance of pregnant females or young may be detrimental. Competition for food resources (all), climate change (all). Pressure on bird colony from rats and cats.	Wildlife Watching		£40,645		

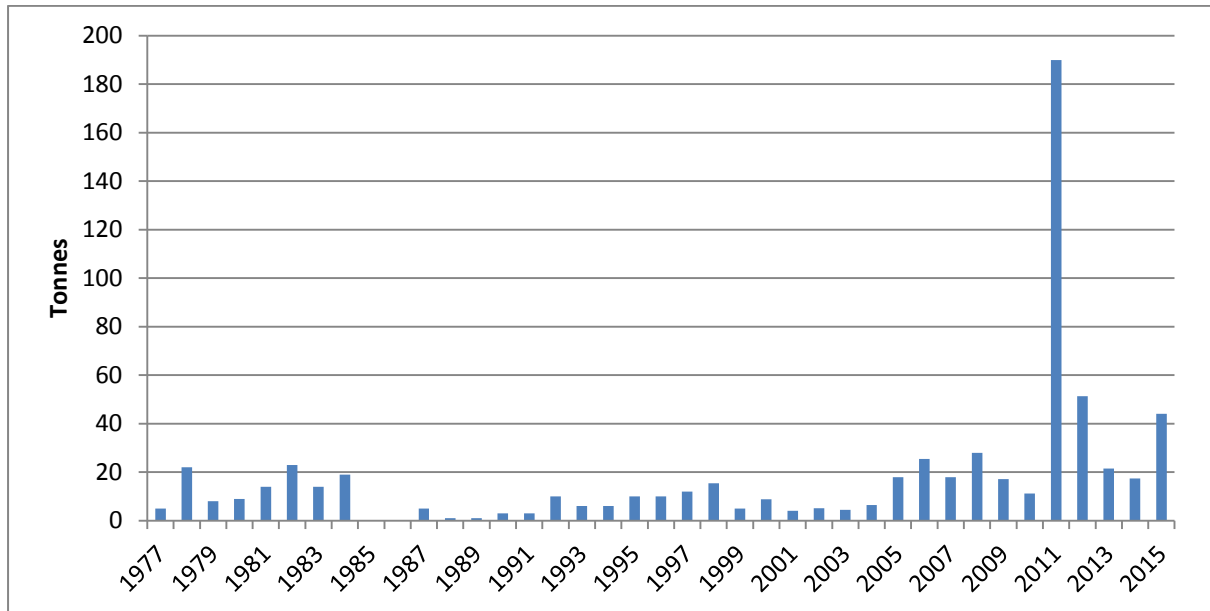
Beneficial ecosystem service	Description	Main targets species	Dependencies	Pressures (same as tourism but specifically)	Indicator	Description	Value 2015/2016	Jobs	Looking Forward
		Scenic trips and island drop off/pick up. As above but wildlife interactions more opportunistic. Pick up and drop offs are to take people out to preferred rock fishing.	<p>Scenic boats trips require a perception/knowledge that the marine environment has natural beauty.</p> <p>Pick up and drop offs e.g. lemon valley require that there are fish to catch. Fishermen target glass eye snapper, mackerel, moray eel, grouper, squirrel fish, soft back soldier and octopus. St Helena wrasse is often used as bait</p>	<p>Overfishing of local sites of limited to low mobility fish species though there are many sites around the island that are inaccessible.</p> <p>Pressure on endemic bait species</p> <p>Localised pollution</p> <p>Rejection of traditional culture by youth. Outside influences and a broader range of lifestyle choices undermine traditional activities and culture.</p>	Scenic trips and island drop off/pick up		£15,240		

Beneficial ecosystem service	Description	Dependencies	Pressures (1 st workshop)	Indicator	Description	Value	Looking Forward (1 st workshop)
Spiritual	<p>In a survey conducted in 2014 by EMD a total of 124 adults asked about the type and frequency of their use of the marine environment around St. Helena (90% of those surveyed were Saints). Along with taking part in recreation activities many participants in the survey also stated that their main interaction with the sea was 'Looking at the sea' and use the sea as a source of 'inspiration'.</p> <p>The spiritual role of the sea in St Helena was stressed significantly at the 1st workshop. Benefits generated include relaxation, health benefits, restfulness, connection with nature, watching the sea (especially when it is rough). Rock fishing is not just about obtaining food, the sea is the setting for romantic liaisons, it provides space to relax and enjoy. Watching the sea is believed to have potential mental health benefits</p>	Spiritual benefits depend on a positive knowledge/perception of the sea to support aspects of human wellbeing.	<p>Erosion of well-being though development;</p> <p>Development of the coastline may reduce access to coast;</p> <p>End of RMS;</p> <p>Modernization of the island;</p> <p>Resort development at the coast;</p> <p>Nowhere to easily sit and be spiritual with the sea;</p> <p>Destruction of key locations and environments through – for example: major pollution incident, rock fall, disease, human destruction; and</p> <p>Walking trails being removed or blocked so people cannot fish where they used to.</p>	Recorded frequency that respondents to the survey state that their main interaction is to 'look at the sea' and use the sea as a source of 'inspiration'.	<p>Survey participants were asked how often they 'look at the sea' and use the sea as a source of 'inspiration'. Responses required were:</p> <p>Never Once a year Once every 6 months Once every 3 months Once a month Once a week Daily</p> <p>Any future reduction in responses that suggest that people spend less time interacting spiritually with the sea could signal a decline in this benefit.</p>	<p>1) Look at the sea'</p> <p>N=84 responses</p> <p>Never =0% Once a year=0% Once every 6 months =0% Once every 3 months = 7% Once a month= 9% Once a week= 38% Daily = 46%</p> <p>2) Inspiration</p> <p>N=47 responses</p> <p>Never =0% Once a year=2% Once every 6 months =2% Once every 3 months = 7% Once a month= 15% Once a week= 38% Daily = 30%</p>	<p>Access to the coast is important to support this service. Infrastructural change – driven by tourism – but infrastructure needed by residents too.</p> <p>Busier lifestyles.</p> <p>More people focused wharf in Jamestown will increase well-being value of the waterfront.</p> <p>Increased cultural activity due to interest from tourism</p>

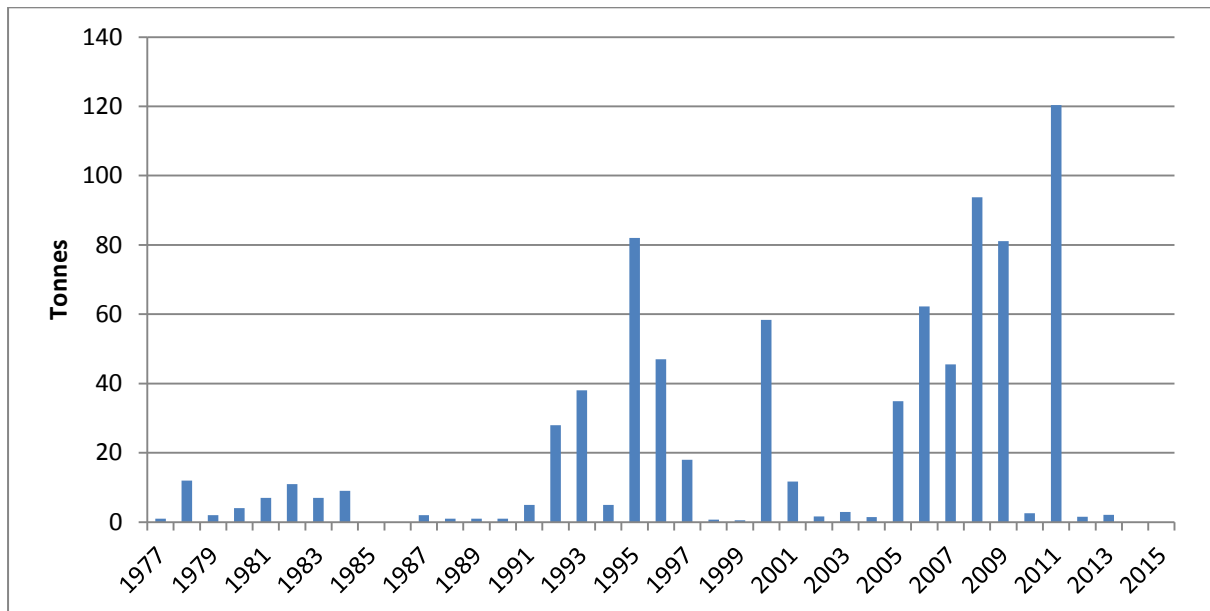
14. Annex IV

The long term variability in landings of Tuna 1977 – 2015. Data from ICAAT and ANRD

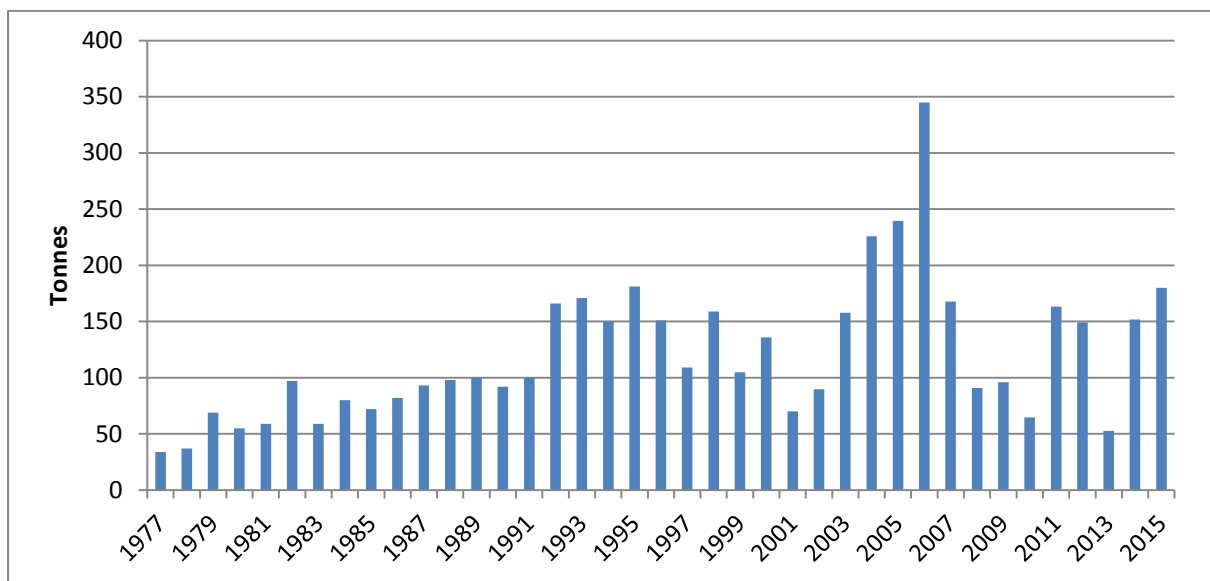
i) Big-Eye



ii) Albacore



iii) Yellow Fin



iv) Skipjack

